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# REPORT ON POLLUTION IN THE LAKE TAHOE BASIN: CALIFORNIA - NEVADA, APPENDIX A. VOLUME 2

A. W. West, et al

Federal Water Pollution Control Administration
Cincinnati, Ohio

July 1966

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## APPENDIX A

# REPORT ON POLLUTION IN THE LAKE TAHOE BASIN

## California - Nevada

by

A. W. West, Sanitary Engineer

K. M. Mackenthun, Aquatic Biologist

in cooperation with the
Southwest Regional Office
San Francisco, California

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

Cincinnati, Ohio

July 1966

# INDEX

PAGE NO.

CONCLUSIONS AND RECOMMENDATIONS . . . . . . . . . . . . 1

SUMMARY . . . . . . . . . . . . . . . . . . . . . . . . 3

ACKNOWLEDGEMENTS . . . . . . . . . . . . . . . . . . . 7

INTRODUCTION . . . . . . . . . . . . . . . . . . . . . 8

WATER USES . . . . . . . . . . . . . . . . . . . . . . 10

SOURCES OF WASTES . . . . . . . . . . . . . . . . . . 12

- INTRODUCTION . . . . . . . . . . . . . . . . . . . . 12
- CORRECTIVE ACTION AND PROPOSALS . . . . . . . . . . 14
  - South Tahoe Public Utility District (STPUD) . 15
  - North Tahoe Public Utility District (NTPUD) . 17
  - Tahoe City Public Utility District . . . . . . 17
  - Incline Village . . . . . . . . . . . . . . . . 18
  - Douglas Co. Sewer Improvement District and Round Hill General Improvement District . . . . 18
  - Proposed Enlarged North Shore Area Public Utility District . . . . . . . . . . . . . . . . 19
  - Governmental Agencies and Local Associations . 20
    - State Agencies . . . . . . . . . . . . . . 20
    - Placer County . . . . . . . . . . . . . 22
    - Lake Tahoe Area Council . . . . . . . . . . 23
  - Present Status of the Problem . . . . . . . . 24

## INDEX (Cont.)

PAGE NO.

NITROGEN AND PHOSPHORUS IN SEWAGE (1966 SUMMER PEAK POPULATION) . . . . . . . . . . . 24

Untreated Sewage . . . . . . . . . . . . . . . . 25

Treated Sewage . . . . . . . . . . . . . . . . . 25

TOTAL NITROGEN AND PHOSPHORUS SOURCES IN THE BASIN (1966 and 2010 AVERAGE ANNUAL) . . . . . . . . . . . 26

Nitrogen . . . . . . . . . . . . . . . . . . . . 26

Present Loads . . . . . . . . . . . . . . . . 26

Future Loads . . . . . . . . . . . . . . . . 26

Phosphorus . . . . . . . . . . . . . . . . . . 27

EFFECTS OF WASTES ON WATER QUALITY AND USE . . . . . 29

EUTROPHICATION . . . . . . . . . . . . . . . . . 29

SILT . . . . . . . . . . . . . . . . . . . . . . 32

PHYSICAL FEATURES . . . . . . . . . . . . . . . . 34

CHEMICAL DATA . . . . . . . . . . . . . . . . . . 34

BIOLOGICAL CONDITIONS . . . . . . . . . . . . . . 36

APPENDIX . . . . . . . . . . . . . . . . . . . . Tables I to VI

# LIST OF FIGURES

| FIGURE NO. | | FOLLOWS PAGE NO. |
|---|---|---|
| 1 | Location Map . . . . . . . . . . . . . . | 1 |
| 2 | Estimated Nitrogen & Phosphorus - Sewage Loads to Tahoe Basin (1966 Summertime Peak) . . . . . . . . | 24 |
| 3 | Estimated Nitrogen Loads - Sources and Net Discharge to Basin (1966 & 2010 Annual Averages . . . . . | 26 |
| 4 | Estimated Phosphorus Loads - Sources and Net Discharge to Basin (1966 & 2010 Annual Averages) . . . . | 27 |
| 5 | Sampling Areas in Lake Tahoe . . . . | 34 |
| 6 | Chlorophyll a in Lake Tahoe . . . . . | 37 |

# LIST OF TABLES

(In Appendix)

TABLE NO.

| | |
|---|---|
| I | Nitrogen & Phosphorus Content of Sewage |
| II | Estimated Sources of Nutrients in Tahoe Basin (Present - 1966 - 58,000 Average Annual Population |
| III | Estimated Sources of Nutrients in Tahoe Basin (Year 2010 - 254,000 Average Annual Population |
| IV | Nitrogen, Phosphorus, Alkalinity and pH of Lake Tahoe (1962) |
| V | Concentration of Phytoplankton in Lake Tahoe (1962) |
| VI | Chlorophyll a Concentrations in Lake Tahoe |

Report of Pollution in the Lake Tahoe Basin, California-Nevada, by A. W. West, Sanitary Engineer and K. M. Mackenthun, Aquatic Biologist, U.S. Department of the Interior, Federal Water Pollution Control Administration, Cincinnati, Ohio, July 1966

# ERRATA SHEET

## APPENDIX A

### TABLE I

The POPULATION and FLOW (mgd) for Incline Village is to be corrected from 11,100 persons and 1.00 mgd to 2,200 persons and 0.10 mgd respectively.

NOTE: When using the report the reader should relate the above corrections to the information appearing in:

a. Tables I, II and III.
b. Figures 2, 3 and 4.
c. Paragraphs 2 and 3, page 4.
d. Paragraphs 2 and 3, page 5.
e. Line 2, table at top of page 13.
f. Line 2, table at top of page 14.
g. Paragraph 1, page 18.
h. Paragraph 1, page 25.
i. Paragraphs 1 and 4, page 26.

# CONCLUSIONS AND RECOMMENDATIONS

Lake Tahoe, one of the clearest freshwater lakes in the world, is an irreplaceable scenic treasure and national resource. To protect it from destruction by man-made pollution and man-accelerated eutrophication is an urgent task of Federal, State, and local government.

Lake Tahoe is threatened by nitrogen and phosphorus pollutants from sewage discharged within the Basin. These pollutants speed up the rate of eutrophication. The phosphorus content of Lake Tahoe water has already reached a critical level. Objectionable algal growths are already present in near-shore areas where phosphorus concentrations are highest. A substantial increase in nitrogen, common in human wastes, could create obnoxious algae throughout the Lake, destroy its clarity and make it distasteful to sight and smell.

Lake Tahoe is threatened with pollution by silt erosion from lands where the natural vegetative cover is destroyed and soil is disturbed by land clearing operations. Silt, transported into the lake by runoff during the rainy season, reduces the clarity and beauty of the water and can destroy aquatic life and adversely change the composition of those organisms that may be present.

Lake Tahoe, the most important resource of the Basin, is used for public water supply, fishing, and all water sports. It now supports a large tourist economy, which is expected to multiply in value several times in the next several decades. The future economy of the region, however, is endangered by waste discharges.

Pollution of Lake Tahoe degrades a resource which, recreationally and aesthetically, belongs to the entire nation. To preserve this natural heritage for all peoples, man-associated pollution must be stopped.

To stop the deterioration of Lake Tahoe now, and to restore the quality of its water where it has already been damaged, the following general improvements should be made:

1. Establish additional public utility districts, or expand the boundaries and jurisdiction of existing districts, to include the entire populated drainage area of Lake Tahoe.
2. Extend public sewer service to collect all sewage from the Lake Tahoe drainage area.
3. Provide a minimum of secondary treatment for all wastes collected in the drainage area.
4. Export all sewage and garbage out of the Lake Tahoe Basin.
5. Minimize the transport of silt into Lake Tahoe by including effective soil conservation and erosion control practices in the clearing, development and use of lands within the Basin.

# SUMMARY

The beauty of interstate Lake Tahoe, one of the clearest fresh-water mountain lakes in the world, is threatened by nitrogen and phosphorus pollutants in sewage and silt from land clearing operations within the Tahoe Basin.

When present above threshold levels in the lake, these nitrogen and phosphorus nutrients can stimulate algal growths and aquatic weeds that can produce surface scums and suspended turbidity which will drastically reduce the clarity and beauty of the lake waters and cause visual and olfactory nuisances. The phosphorus content of Lake Tahoe waters already approaches a critical level, and a substantial increase in nitrogen content could induce noxious algal blooms in Lake Tahoe. The nitrogen content in human wastes, that may drain into Lake Tahoe, poses the most serious threat to preservation and continued full enjoyment of this invaluable national resource.

The clarity of onshore waters is reduced where silt erosion from land clearing operations is transported into the lake by runoff during the rainy season.

The Lake Tahoe Basin is a scenic recreational wonderland for tourists, vacationists, visitors and residents alike. Lake Tahoe is used for public water supply, water-oriented sports such as boating, skiing, and fishing, and provides immeasurable aesthetic enjoyment to all who visit and support the economy of the area.

During the peak of summer recreational activity, population has grown from about 132,000 in 1962 to an estimated 180,000 in 1966. It is estimated that all available accessible land will have been developed by 2010, at which time the summer peak population is expected to reach 596,000.

Approximately 3,680 pounds of nitrogen per day and 489 pounds of phosphorus per day are presently contained in the sewage discharged within the Basin during the summertime. The major part of these loads, 62 percent of the nitrogen and 84 percent of the phosphorus, are discharged in the areas that are not served by community sewers. Nitrogen and phosphorus contained in sewage discharges will increase apace with increased population.

Public utility districts provide community sewers and treatment facilities in the more densely populated areas. Treated sewage containing nitrogen and phosphorus is discharged to spray irrigation and percolation disposal areas within the Basin.

Significant amounts of nitrogen (approximately 10 percent of all sources) and phosphorus (approximately 25 percent of all sources) are contained in refuse and garbage produced within the Basin.

The consultants* have concluded that after equilibrium has been reached, nitrogen contained in the effluents from municipal sewage treatment plants, residential septic tanks, and in refuse and garbage that is disposed of within the Basin will ultimately be transported into Lake Tahoe by surface drainage and subsurface seepage.

South Tahoe Public Utility District, the second largest source of nitrogen, discharges 29 percent of the sewage-associated nitrogen but only 1 percent of the phosphorus. Incline Village discharges 5.4 percent of the nitrogen and 8.2 percent of the phosphorus, while the North Tahoe Public Utility District discharges 4.4 percent of the nitrogen and 7.0 percent of the phosphorus. Effluent from the Tahoe City sewage treatment plant drains out of the Tahoe Basin.

At present (1966), approximately 1,090,000 pounds per year of nitrogen originate within, or enter, the Tahoe Basin with sewage, runoff, rain and refuse. Sewage accounts for almost one-half (47.5 percent) of this amount, and present sewage and refuse disposal practices eliminate only 12 percent of the total.

The amount of nitrogen contained in sewage will increase 5-fold by 2010, at which time it will account for approximately 75 percent of the 3,597,000 pounds per year of nitrogen sources in the Basin.

The 2010 nitrogen load may be reduced 50 percent, to 1,820,000 pounds per year, by conventional secondary treatment, or 92 percent, to 745,000 pounds/year if successful tertiary nitrogen-removing treatment processes are developed by that time. Rain and runoff alone will account for 530,000 pounds/year annually.

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* McGauhey, Eliassen, Rohlich, Ludwig & Pearson.

Objectionable blue-green algae and filamentous green algae are now present in some near-shore areas of Lake Tahoe. Also, the available phosphorus concentration in some near-shore areas is now at levels believed to be critical for the stimulation of algal growths. There are indications that algal growths may become obnoxious if the waters become further enriched.

## ACKNOWLEDGEMENTS

The June 1963 report, "Comprehensive Study on Protection of Water Resources of Lake Tahoe Basin Through Controlled Waste Disposal," *prepared for the Lake Tahoe Area Council by Board of Consultants, P. H. McGauhey, Rolf Eliassen, Gerard Rohlich, Harvey F. Ludwig, and Erman A. Pearson, has been used as the source of the basic and projected data referred to in this report.

Information concerning recent legislation, action by State and local authorities, and the status of sewage treatment practices at local public utility districts was provided by Irving M. Terzich, Sanitary Engineer, Southwest Regional Office, Federal Water Pollution Control Administration, Department of the Interior, San Francisco, California.

The valuable assistance provided by representatives of the California Department of Public Health, the California State and Lohontan Regional Water Pollution Control Boards, the Nevada Department of Public Health, the Nevada Department of Conservations and Natural Resources, County health departments and local public utility districts, and the Lake Tahoe Area Council is gratefully acknowledged.

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* Referred to hereafter as the "Consultants' Report".

# INTRODUCTION

Lake Tahoe, astride the California-Nevada state line in the Sierra Nevada Mountains, is one of the clearest, deepest freshwater lakes in the world. Situated at an elevation of 6,225 feet, Lake Tahoe is 192 square miles in area (122,880 acres) and has a length of 21.6 miles and a width of 12 miles. The lake's maximum depth is 1,645 feet, its mean depth is 990 feet, and its volume is approximately 122 million acre feet. The 1200-foot depth contour is often less than a mile from the nearest shore, and never more than three miles. The Tahoe drainage basin is 506 square miles.

Average annual precipitation in the Basin amounts to 27 inches per year, of which 60 percent is snow. Runoff from more than 60 tributary streams averages 307,900 acre feet, which when added to 205,000 acre feet of precipitation over the lake, amounts to 512,900 acre feet of water per year entering Lake Tahoe. The 332,000 acre feet/year average evaporation loss (32 inches/year) reduces the average net yield to 180,900 acre feet/year. There is no net yield during dry years when evaporation losses exceed precipitation and runoff.

Controlled discharge from Lake Tahoe into the Truckee River varied from a 656,900 acre feet/year maximum (1907) to a 4,700 acre feet/year minimum (1931) to average 176,000 acre feet/year during the 1901-1962 period of record. Approximately 5,000 acre feet/year are exported out of the Basin via the Marlette Lake, Third Creek and Echo Lake diversions.

As the growth of resident and tourist populations alike increases at an accelerated rate, the problems associated with sewage and other waste disposal are magnified and the rare clarity and beauty of Lake Tahoe waters are threatened by algal nuisances that may arise from the nitrogen and phosphorus contained in these wastes. Likewise, silt from land clearing practices and real estate development is an increasing problem.

This report discusses the nutrient and silt problems, the present status of sewage treatment and disposal. the water quality characteristics of lake waters, and the pollution abatement proposals designed to protect and preserve the quality and beauty of the interstate waters of Lake Tahoe.

# WATER USES

Lake Tahoe, the sparkling jewel-like heart of this vacation wonderland, is the irreplaceable scenic attraction for campers, tourists and visitors alike, who flock to this mountain retreat in ever increasing numbers.

The shimmering crystal clear water soothes and relaxes those who come to view Lake Tahoe's magnificent splendor. It invigorates and rejuvenates those who boat, ski, fish and swim. It is a source of public water supply and, as the focus for recreational tourism, helps support the economy and welfare of those residing in both the California and Nevada sections of the Basin.

In 1962, 32 agencies, serving more than 16,000 persons, used Lake Tahoe as a source of domestic water supply. More than 8,000 persons receive water from systems that distribute lake water without treatment.

Approximately 48 percent of the land area in the Tahoe Basin is owned by the U. S. Forest Service and by State and County parks. The California-Nevada Interstate Park Commission is studying the feasibility of purchasing additional land along the east basin wall. These lands, with facilities for picnicking and camping, are used extensively by tourists who visit the lake for boating, fishing, and water skiing.

It is imperative that this unique national resource be preserved and protected for full enjoyment by present and future generations.

# SOURCES OF WASTES

## INTRODUCTION

The nitrogen and phosphorus nutrients contained in sewage and other waste discharges within the Tahoe Basin threaten the splendor of Lake Tahoe.

When present above threshold levels in lake water, these elements can stimulate excessive algal and aquatic weed growths that may produce unsightly surface scums and suspended turbidity that can reduce drastically the clarity and beauty of lake waters.

Sewage-associated nutrient loads are increasing in proportion to the rapid population growth in the Basin. The number of people residing in the Lake Tahoe Basin varies throughout the seasons of the year according to the influx of tourists who visit the area to enjoy summer vacations, winter skiing and year-round gaming in this recreational area. Maximum population densities occur in August.

Summer peak and annual average population estimates for 1962, 1966 and 2010 are shown in the following table:

| Year | Estimated Summer Peak Population | Annual Average as % of Summer Peak | Estimated Total Annual Average Population |
|---|---|---|---|
| 1962 | 132,000 | 30 | 40,000 |
| 1966 | 180,000 | 32 | 58,000 |
| 2010 | 596,000 | 43 | 254,000 |

All sewage collected by community sewers is treated in plants which remove approximately 80 percent of the phosphorus but only 35 percent of the nitrogen. Sewage from residences not served by community sewers is discharged to septic tanks which remove little, if any, phosphorus or nitrogen. Effluents from the treatment plants are disposed of by spray irrigation or percolation, and those from septic tanks by subsurface seepage. The consultants conclude that, after equilibrium is reached, most of the nitrogen discharged to disposal areas within the Basin, including those serving individual residences, will be transported into the lake by surface drainage and subsurface seepage.

Refuse and garbage also contain significant amounts of nitrogen (approximately 10 percent of all sources) which can be transported to the lake by drainage and seepage unless exported out of the Basin.

During the rainy season, silt eroded from soils ripped up during land clearing and development is flushed into the lake and reduces the clarity of waters in the near-shore areas.

The types of sewage treatment provided in the Tahoe Basin is summarized as follows:

| Estimated Connected Population (1966 Summertime Peak) | % of Connected Population | Type of Treatment |
|---|---|---|
| 114,700<br>(unsewered areas) | 64% | Privies, septic tanks, plus soil absorption |
| 20,800<br>(Incline Village, No. Tahoe Pub. Util. Dist., Tahoe City) | 11% | Public sewers, secondary treatment plus spray irrigation or soil absorption |
| 44,500<br>(So. Tahoe Pub. Util. Dist., including Round Hill & Douglas Co. Utility Districts) | 25% | Public sewers, tertiary treatment plus spray irrigation and soil absorption |

Since these treatment facilities provide adequate protection against damage to water quality of the lake by other sewage constituents, such as oxygen-demanding organic matter and sewage bacteria, the discussion of pollutants in waste sources is limited to phosphorus, nitrogen and silt.

## CORRECTIVE ACTION AND PROPOSALS

Approximately two-thirds of the estimated 1966 summertime population are not served by the existing municipal sewerage systems. Sewage from this major segment of the population is disposed of in privies or septic tanks which permit seepage of nitrogen and phosphorus into the subsoil formation that drain towards the lake.

Approximately one-third of the population is served by the following six public utility and improvement districts that provide community facilities for sewage collection, treatment and disposal:

California

South Tahoe Public Utility District
North Tahoe Public Utility District
Tahoe City Public Utility District

Nevada

Incline Village
Douglas County Sewer Improvement District
Round Hill General Improvement District

### South Tahoe Public Utility District (STPUD)

The South Tahoe Public Utility District sewage treatment plant serves approximately 44,000 persons in the South Tahoe Public Utility District in California, and the Douglas County Sewer Improvement District and the Round Hill General Improvement District in Nevada. This treatment facility consists of conventional primary sedimentation with sludge digestion, secondary activated sludge biological treatment and chlorination. Additional tertiary treatment in the form of chemical treatment followed by sand filtration and contact in a carbon filter, is provided for phosphorus and organic nitrogen removal. Final effluent is equalized in a holding pond and then discharged to percolation beds and spray disposal areas in forested land.

These facilities were designed to treat two and one-half million gallons of sewage per day, but sewage flows have increased above design capacity to reach four million gallons per day during the summer of 1965.

During excessive flows, the effluent that could not be disposed of in the percolation beds overloaded and saturated the land areas used for spray disposal and a part of the treated effluent joined the natural surface runoff to Lake Tahoe.

The combined primary, secondary, and tertiary treatment facilities are designed to remove approximately 30 percent of the nitrogen and 98 percent of the phosphorus contained in the raw sewage.

The District has been granted at $1,800,000 State loan, has qualified for more than $3,000,000 in grants from the Federal Economic Development Agency and has authorized issuance of bonds for construction of additions to the treatment and disposal facilities. The District and the U. S. Forest Service are presently evaluating proposals for collection and transmission of sewage from the Pope-Baldwin Recreational Area to the STPUD facilities.

The District plans to expand the existing treatment facilities to provide seven and one-half million gallons per day capacity, proposes to construct an additional tertiary treatment plant for ammonia nitrogen removal, and expects to construct pumping and transmission facilities to transport the final effluent out of the Basin over Luther Pass and into Alpine County, California, for ultimate disposal to spreading beds in the Carson River Valley below Woodfords.

## North Tahoe Public Utility District (NTPUD)

The North Tahoe Public Utility District sewage treatment plant, serving approximately 8,000 persons, consists of primary sedimentation with separate sludge digestion and chlorination facilities. Treated effluent is disposed of by percolation in trenches which, because of their large capacity, presently serve as waste stabilization ponds to provide the equivalent of secondary treatment prior to ultimate ground disposal.

Tests in 1962 indicated that these primary treatment facilities removed approximately 23 percent of the nitrogen and 16 percent of the phosphorus contained in the raw sewage.

The District is considering joining a proposed enlarged North Shore Public Utility District for exporting of all sewage out of the Basin.

## Tahoe City Public Utility District

The Tahoe City Public Utility District sewage treatment facilities, serving approximately 1,700 persons, consists of primary sedimentation with separate sludge digestion followed by a secondary trickling filter plant. The effluent is disposed of by spray irrigation and percolation trenches. The disposal area is located in the Truckee River Basin and therefore no effluent reaches the Tahoe Basin. This area is also considering joining the proposed North Shore Public Utility District.

## Incline Village

The Incline Village sewage treatment facilities, serving approximately 11,100 persons, include an activated sludge type secondary treatment process equipped for chlorination and diatomite filtration of the effluent. The effluent is stored in reservoirs and then discharged to a sprinkler system at the local golf course or to a spray disposal system in the nearby woods.

It is estimated that the secondary treatment facilities remove approximately 52 percent of the nitrogen and 40 percent of the phosphorus contained in the sewage.

The State of Nevada proposes to enact enabling legislation which would, in effect, permit Incline Village to join public utility districts in California. Incline Village will consider joining the proposed North Shore Public Utility District if appropriate State-enabling legislation is passed.

## Douglas County Sewer Improvement District and Round Hill General Improvement District

Sewage from these two districts is presently discharged to the adjacent South Tahoe Public Utility District collection system for treatment and ultimate disposal.

These two districts plan to combine in a joint venture to collect and treat sewage from the two districts and export the treated effluent out of the Basin over Daggett Pass into the drainage basin of the Main Carson River in Nevada. The Districts have voted bonds (Douglas County, 3.0 million dollars; Round Hill, 3.0 million dollars) for their share of the costs. They have been offered a $700,000 F.W.P.C.A. construction grant for 1966, and the State of Nevada proposes to allow an additional $800,000 of anticipated 1967 F.W.P.C.A. construction grant funds to assist in completion of the sewage treatment plant and effluent export system.

## Proposed Enlarged North Shore Area Public Utility District

Residents of the North Tahoe Public Utility District, the Tahoe City Public Utility District, and other unsewered areas along the north and west shores of the lake are considering formation of a proposed enlarged inclusive North Shore Area Public Utility District. The District would extend from Bliss State Park in Eldorado County in California to the California-Nevada State line, and would include the two existing public utility districts and all contiguous land areas. Incline Village could be included in the proposed new district if Nevada passes appropriate enabling legislation.

This plan includes collection of all sewage within the District boundaries in the Tahoe Basin. A transmission line along the Truckee River would convey this sewage, and sewage from Alpine Meadows, Squaw Valley, Donner Lake, and the city of Truckee, California to a proposed secondary treatment plant near Truckee, California. According to the plan, treated effluent would be pumped to a disposal area in Martis Valley where it would percolate to mingle with the ground water and ultimately appear in the Truckee River.

## Governmental Agencies and Local Associations

Local and State associations, and government agencies having an interest in the lake, recognize the need to abate pollution that threatens Lake Tahoe, and have accepted the consultants' recommendation that sewage treatment plant effluents should be exported out of the Basin. Engineering investigations have been completed, field studies continue, sanitation ordinances are in effect, interstate compact groups have been organized, enabling legislation has been passed, and sewage treatment plants have been constructed. Though commendable progress has been made, the complex pollution problem remains and is intensified by accelerated residential, recreational and commercial growth in the Basin.

State and local action, directed towards ultimate solution of the pollution problem. is summarized as follows:

### State Agencies

1. Regulatory agencies in both California and Nevada prohibit the discharge of wastes or waste effluents which would reach either Lake Tahoe or the Truckee River by surface flow.

2. Senate Bill No. 22 adds Section 13065 to the California State Water Code. This section of the Water Code prohibits the use of cesspools or other means of sewage or industrial waste disposal in any district of the Lake Tahoe Basin where a waste collection system, treatment facilities and export of the treated effluent from the Basin are provided.

3. Assembly Bill No. 2618 (Chappie, Lunardi) Regular Session, 1965, adds Section 1, Division 22 (Sections 77000 to 84700) to the California State Water Code. This is enabling legislation permitting the formation of sanitation authorities by two or more public agencies (without requirement of contingency) to provide sewerage facilities.

4. Nevada is considering enactment of enabling legislation which would in effect permit Incline Village in Nevada to join the North Shore Public Utility District (when formed) in California for the collection, treatment and disposal of sewage.

5. Representatives, one for the State of California and one for the State of Nevada, were appointed to assist local agencies, assess progress in the Basin, and report to and advise the State governors on all matters pertaining to the protection of the quality of waters in the Tahoe Basin and to recommend such action as may be necessary.

Mr. John T. Leggett, executive officer of the Lahontan Regional Water Quality Control Board, was appointed for California and Mr. Wallace W. White, Director of the Nevada State Department of Health and Welfare was appointed for Nevada.

6. A California-Nevada Joint Interstate Compact Commission has been formed to develop a compact for allocation of the waters of Lake Tahoe and the Truckee, Carson and Walker rivers.

Representatives of the Federal Water Pollution Control Administration have supported the intent of the provisional compact to maintain existing excellent water quality of the interstate waters, but objected to provisions that would require that no waste waters be exported from the Lake Tahoe Basin without permission of the compact commission. The F.W.P.C.A. contend that the export of waste waters is essential at this time to protect the extraordinary clarity of Lake Tahoe and that certain conditions in the provisional compact, particularly those relative to preventing a reduction of flow available to the Truckee River water users, could delay and perhaps even preclude the export of waste waters.

7. Senate Bill No. 17 of the California Legislature authorizes a loan fund in the amount of 1.8 million dollars to the South Tahoe Public Utility District to permit the extension of export facilities from the summit of Luther Pass to Diamond Valley in Alpine County, California.

8. A California-Nevada Joint Water Quality Investigation group collects chemical, biological, and microbiological samples from stations on the lake four times per year to monitor water quality and report changes or trends that may become evident. The Federal Water Pollution Control Administration assists this group by analyzing the biological samples.

## Placer County

The Placer County, California, Board of Supervisors engaged Engineering-Science, Inc. to study waste disposal alternatives for the North Shore area of Lake Tahoe. In the February 1965 report to the Board of Supervisors, Engineering-Science, Inc. delineated logical public utility district boundaries, provided cost estimates, and discussed the relative merits of alternate schemes for exporting North Shore sewage out of the Basin.

### Lake Tahoe Area Council

The Lake Tahoe Area Council has engaged a nationally recognized board of consultants to study and report on sewage and waste problems in the Basin and recommend means to protect the clarity and beauty of Lake Tahoe.

This and other projects were aided by grants from the Max Fleischmann Foundation.

Basic information, evaluations, and recommendations by the board of consultants are given in the consultants' June 1963 report, "Comprehensive Study on Protection of Water Resources of Lake Tahoe Basin Through Controlled Waste Disposal." The consultants' report includes population statistics, nitrogen and phosphorus loads in sewage and refuse for 1962, and estimates the natural and man-made nutrient loads that may prevail in the Year 2010. It discusses the effects of nutrients on lake waters, and concludes that refuse and sewage treatment plant effluents should be exported from the Basin to provide an immediate correction for water pollution problems within the Basin.

The Council has received an additional $17,500 grant from the Max Fleischmann Foundation to finance an additional engineering study to implement a comprehensive basin-wide plan for exporting sewage and sewage treatment plant effluents from the Basin.

The Council has also received a Federal Water Pollution Control Administration demonstration grant in the amount of $74,000 to determine the kind and amounts of nutrients and growth stimulants which tend to start or encourage the growth of algae in freshwater lakes. Pilot scale tests will be made to determine the sensitivity of Lake Tahoe waters to sewage treatment plant effluent, septic tank effluent, surface wash from natural vegetated areas and pollutants resulting from land or shoreline management activities of various kinds. The project will be conducted by the Lake Tahoe Area Council's board of consultants, headed by Professor P. H. McGauhey of the University of California at Berkeley.

## Present Status of the Problem

Despite present accomplishments, areas responsible for approximately two-thirds of the sewage-associated nitrogen discharges are not served by community sewers or treatment facilities; sewage flows exceed the capacity of the South Tahoe Public Utility District's treatment plant, and sewage plant effluents are still disposed of within the Basin. Nutrients from these sources in Nevada and California continue to threaten the beauty and full enjoyment of Lake Tahoe and endanger the welfare of both California and Nevada residents of the Basin.

## NITROGEN AND PHOSPHORUS IN SEWAGE (1966 SUMMER PEAK POPULATION)

The estimated 1966 summertime peak nitrogen and phosphorus loads in treated and untreated sewage originating within the Tahoe Basin are summarized in Table I and illustrated on Figure 2.

## Untreated Sewage

The major source of sewage-associated nitrogen and phosphorus originates in areas not served by the community sewers and treatment systems (Figure 2, Table I). The unsewered areas include the residences provided with septic tanks and the camp sites which are furnished with chemical pit privies. Approximately 62 percent of all nitrogen and 84 percent of all phosphorus in sewage discharges originates from these unsewered areas. The urgent need for basin-wide community sewerage systems, for effective nutrient removal, is accentuated by this disproportionately large nutrient load from the unsewered areas.

## Treated Sewage

Effluent from the South Tahoe Public Utility District sewage treatment plant, which also serves the Bond Hill and Douglas County Improvement Districts, is the second largest source of sewage-associated nitrogen. The effluent from this plant contains 29 percent of the nitrogen, but only 1 percent of the phosphorus.

Treated sewage from Incline Village contains 5.4 percent of the nitrogen and 8.2 percent of the phosphorus, while that from the North Tahoe Public Utility District plant contains 4.4 percent of the nitrogen and 7 percent of the phosphorus.

Effluent from the Tahoe City sewage treatment plant drains into the Truckee River Basin and therefore does not contribute nitrogen or phosphorus to the Tahoe Basin.

## TOTAL NITROGEN AND PHOSPHORUS SOURCES IN THE BASIN (1966 and 2010 AVERAGE ANNUAL)

### Nitrogen

#### Present Loads (1966 estimates)

In 1966 almost half (47.5 percent) of the 1,090,000 pounds per year of nitrogen produced by all sources originated in sewage, 8.1 percent originated in refuse and the remaining 44.4 percent came from rain and runoff. (Figure 3, Table II)

Current sewage treatment practices, which remove only 17 percent of the nitrogen in sewage on the average, do not effectively protect the Basin against nitrogen pollution from man-made sources. Sewage treatment, and export of approximately one-half of the refuse, will remove only 12 percent of the nitrogen, and allow 958,000 pounds per year to be discharged within the Basin.

#### Future Loads (2010 estimates)

The consultants estimate that practically all suitable accessible lands will have been developed by 2010, at which time the peak summertime population will have increased to about 600,000 persons and the average annual population will have increased to 254,000. By that time the total nitrogen sources will have increased to approximately 3,597,000 pounds per year. Approximately 75 percent of this total will originate in sewage, 11 percent in refuse and the remaining 14 percent in rain and runoff.

Sewage flows will increase apace with population growths, and the nitrogen in untreated sewage sources alone will have increased five-fold to approximately 2,700,000 pounds per year by 2010, and will amount to 75 percent of the total 3,600,000 pounds per year nitrogen load from all sources. (Figure 3, Table III)

Even when conventional secondary treatment is provided for all sewage, the 2010 total net nitrogen discharges to the Basin would double the present 1966 load and contribute 1,820,000 pounds of nitrogen per year to the Basin.

If efficient practical nitrogen-removing tertiary processes can be developed for full scale use in 2010, the total nitrogen load may be reduced to 745,000 pounds per year. A residual of approximately 530,000 pounds per year in rain and runoff would remain if all sewage and wastes were exported out of the Basin.

## Phosphorus

Figure 4 illustrates the phosphorus loads in the Basin. In 1966, the 183,800 pounds per year source of phosphorus is reduced 31 percent, to 126,500 pounds per year, by sewage treatment and by exporting about 50 percent of the refuse. (Figure 4, Table II)

The total amount of phosphorus from all sources is estimated to increase approximately four times by the year 2010; at which time approximately 720,000 pounds per year will be produced in the Basin. Based on the successful experience at the South Tahoe Public Utility District, 98 percent phosphorus removal may be obtained from properly designed and operated tertiary treatment plants. It is estimated, therefore, that approximately 72,000 pounds of phosphorus per year, which would amount to 57 percent of the 1966 load, would be discharged within the Basin in 2010, providing all refuse were exported from the Basin and all sewage received appropriate tertiary treatment. The estimated load could be reduced to 53,000 pounds per year if all sewage were exported out of the Basin.

# EFFECTS OF WASTES ON WATER QUALITY AND USE

## EUTROPHICATION

Eutrophication refers to the enrichment of waters by nutrients through man-created or natural means. Natural enrichment produces a rate of lake aging that may be measured only by the clock of geologic time. Additional fertilization accelerates this rate, making changes in water quality that are noticeable within a few decades or even less. It is obvious, for example, that growing cities and expanding industries are pouring nutrients into the Nation's waterways at an accelerating rate, and that aquatic weed and algal nuisances have increased in areas where they did not exist before, and have magnified in areas where there was only a tolerable growth.

The scope of accelerated eutrophication, or water enrichment, is broad. The most perceptible characteristics to the layman include change in water color, increase in turbidity, nuisance growths of small suspended plants or algal scums, developing areas of rooted water plants, and odors associated with decaying dead vegetation. More subtle changes can be found by the scientific investigator as indicated by decreased light penetration; decreased dissolved oxygen in deeper waters; increased nitrogen and phosphorus concentrations, especially in the deeper waters; significant changes in the algal population, the kinds and numbers of bottom-dwelling organisms and fish, and increased rooted aquatic weed beds.

Present knowledge indicates that the fertilizing elements contributing most to lake eutrophication are nitrogen and phosphorus. Iron is also important. Vitamins such as $B_{12}$, many micronutrients, and extracellular products from existing plant populations play a role in the developing aquatic plant growths, but this role is not presently well understood. Sewage and sewage effluents contain generous amounts of those nutrients necessary for abundant algal development.

Many eutrophic lakes throughout the country and the world have been fertile reservoirs for algal development for many years. Notable among these in the United States are Lake Zoar in Connecticut, Lake Sebasticook in Maine, the Madison Lakes in Wisconsin, Lake Erie, the Detroit Lakes in Minnesota, Green Lake and Lake Washington in Washington, and Klamath Lake in Oregon.

As nutrient concentrations increase, the numbers of algal cells usually increase. Nuisance conditions, such as unsightly surface scums and algal-littered beaches, occur. The water may become foul-smelling. Filter-clogging problems may occur at municipal water treatment plants. Filamentous algae, especially Cladophora, grow profusely on nearly any suitable subsurface. These can cause nuisances when they break loose and wash ashore to form windrows of stinking vegetation. Induced acceleration of this normally slow natural process is not in the best interests of man.

At the present time, the waters of Lake Tahoe are not enriched, nor do they support dense algal populations. Threats of future problems are serious, however. The phosphorus concentration in some near-shore areas is now at a critical level for the stimulation of algal growths, and all of the phosphorus present as shown by analytical tests is available for algal utilization. Available nitrogen concentration is presently low and is believed to be the major nutrient limiting algal development beyond the lake's present capacity. Potentially nuisance-producing blue-green algae and filamentous green algae are now present in some near-shore areas of the lake. Furthermore, the impact of nutrients from inflowing streams on the lake water was demonstrated by increased phosphorus concentrations and, in some cases, increased algal concentrations. Presently, this impact is limited to the near-shore waters surrounding the stream's mouth.

## SILT

Silt, eroded from lands where the natural vegetative cover has been destroyed during land clearing operations, is transported into Lake Tahoe by runoff during the rainy season.

Clearing and excavation of land for housing and commercial development, timber harvest, sand and gravel mining, highway construction and other land uses that disturb the ground surface can create or intensify soil erosion problems. Newly exposed ground surfaces and disturbed duff contribute increased amounts of dissolved nitrogen and phosphorus to the runoff. Silt, reaching the lake during runoff, increases the turbidity and reduces the clarity of onshore waters and increases bottom deposits that can smother fish food organisms.

Soil erosion and silt transport can be reduced by seasonal scheduling of land clearing projects to permit restoration or stabilization of disturbed soils before they are subjected to the severe impact of heavy storms during the rainy season. Diversion dykes or channels provided upslope from areas scheduled for clearing can divert runoff around the work area and reduce erosion of the disturbed soils. Where applicable, silt collection basins, or cut-off dams, below work areas can reduce silt transport and prevent gully formation. All disturbed soils should be stabilized, restored or planted with flow retarding vegetative cover as soon as possible. Excavated material should be properly disposed of to prevent its being flushed into the lake or tributary watercourses.

Provision of temporary cut-off walls at the lake shore during construction of new boat channels extending from the lake into marinas or residential and commercial developments can minimize the transport of suspended silt from the construction site into the lake. Newly constructed banks should be stabilized and made impervious to erosion and scour.

Road and highway cut and fill slopes should be stabilized and revegetated. Highway drainage facilities should be provided with properly designed impervious inlet and outlet structures that will effectively prevent erosion and undermining at these critical locations.

Logging should be conducted according to approved forest management practices to preclude rapid detimbering of large areas and repeated use of the same skid trails. Protective strips of undisturbed land should be allowed to remain on each side of permanent streams.

The silt pollution problem, which can also be magnified by increased population growth and more intensive land use within the Basin, should be abated by following appropriate effective soil conservation and erosion control practices in all present and future land development operations.

## PHYSICAL FEATURES

Temperature data indicate that the lake stratifies and that a thermocline (a zone of greatest vertical temperature change) occurs at a depth of 50 to 70 feet during the summer months. Complete overturn of the waters of Lake Tahoe has not been observed but may occur during winters of unusual severity.

Observations have been made on the transparency of the water in the lake by viewing a white disc, approximately 8 inches in diameter, as it was lowered in the water. The white disc was observed to a depth of 136 feet at one of the stations on April 4, 1962. This may be compared to a transparency value of 5 feet, or less, in an eutrophic lake with a heavy algal bloom. A minimum transparency of 49 feet was observed in Emerald Bay of Lake Tahoe on May 21, 1962; this was associated with a relatively high concentration of plankton at the time the measurement was made. Transparency measurements have been made on several occasions over the years on Lake Tahoe by different investigators. No significant long-term trend in the transparency of the lake can be detected from observations made during the past 90 years.

## CHEMICAL DATA

Samples were collected both seasonally and at various depths from 13 general sampling locations (Figure 5). These were divided into offshore stations (Stations 1 through 4 with depths greater than 150 feet) and near-shore stations (Stations 5 through 13 with depths less than 150 feet). The data indicate in general only minor differences in chemical composition from the water's surface, mid-depth, and bottom. A seasonal change among May, July, September and December samples with respect to depth also was not evident generally.

The average alkalinity was 45 mg/l as calcium carbonate and the minimum value was 41 mg/l. Likewise, the pH varied only from 8.3 to 7.3 and averaged 7.8 (Table IV).

Two of the major nutrients, nitrogen and phosphorus, are always of interest in connection with lake investigations because of their role in biotic production and in nuisance plant growths. Samples were analyzed from 12 offshore sampling points and 45 near-shore points for nitrate nitrogen (N) and soluble phosphorus (P) during both May and July (Table IV). Nitrate nitrogen was present in an average concentration of 9.2 μg N/l (parts per billion) in May and 8.0 μg N/l in July in the offshore areas, and 6.4 μg N/l during both months at the near-shore stations. Concentrations of ammonia nitrogen, nitrite nitrogen and organic nitrogen were below the analytical limits. The average concentration of soluble phosphorus was 5.1 and 10.9 μg P/l in May and July respectively in the offshore areas and 6.1 and 8.7 μg P/l in May and July respectively in the near-shore areas. No significant difference between concentrations o[illegible]uble and total phosphorus was found, indicating that all p[illegible]s was in the soluble form.

The nitrogen values are very low whereas the phosphorus values closely approach those believed to be critical for algal blooms. Of these two major nutrients, nitrogen would appear to be limiting to algal development. Total phosphorus concentrations were generally higher in July than in May because of higher values at some near-shore and deep-water points. These higher values may be due either to the liberation of phosphates from the littoral sediments or to the influence of tributary streams and pollution from man's activities. Areas 6, 8, and 13 (Figure 5) were chosen to investigate possible effects of stream discharge on the nitrogen and phosphorus concentration of near-shore waters and effects on plankton concentrations resulting from such discharges. The concentration of phosphorus was increased in the near-shore waters by these streams, but the increase was not evident generally at a distance of 600 or 700 feet from shore. In area 7, a small craft harbor at Tahoe City, the total phosphorus concentration in July was increased by 2 to 3 times that in May, possibly by man's activities, and the phytoplankton (algal) concentration responded with a similar increase to 3,890 organisms per milliliter in July.

## BIOLOGICAL CONDITIONS

A total of 39 samples was collected from a depth of about 100 feet for plankton counts (Table 5) and for chlorophyll determinations. Essentially all of the phytoplankton were diatoms. All counts were less than 500 organisms per ml with the exception of near-shore areas

7, 12 and 13 (Tahoe City boat harbor, Bijou and upper Truckee River inlet area). The Tahoe City boat harbor had 1,260 organisms per ml in April and 3,890 in July; both are considered algal blooms.

At the time that phytoplankton collections were made, water samples were analyzed for chlorophyll; the July results are shown in Table VI. Chlorophyll is the green coloring matter in plants, and chlorophyll in water samples is indicative of the presence of algae. Although chlorophyll a concentrations are considered low with a maximum July concentration of 1.74 mg/m$^3$ (milligrams per cubic meter), areas where the chlorophyll a concentrations are greatest are located around the south and east near-shore stations and at offshore area 4 (Figure 6). Other areas of the lake have values less than 0.3 mg/m$^3$.

Organisms that are able to attach themselves to the surface of an object were studied by means of microscopic glass slides that were suspended in the lake water at different depths and removed at weekly intervals and examined microscopically. Bacteria outnumbered all other organisms and in some cases were the only organism found.

Although organisms of the type that produce objectionable growths such as filamentous algae, including blue-greens, are already present in near-shore areas, they are not now excessive because of low nutrient concentrations and a resulting low growth rate.

Lake Tahoe contains 122 million acre feet of water that now does not support nuisance algal blooms. It could support these obnoxious growths in many areas if further enriched. It is imperative that the man-associated nutrients not be permitted to enter the lake if Lake Tahoe is to remain clear and beautiful.

# APPENDIX

Table I

NITROGEN & PHOSPHORUS CONTENT OF SEWAGE

Estimated 1966 Summertime Peak Load

Tahoe Basin

| SOURCE | POPULATION | | FLOW | RAW SEWAGE | | | REMOVALS | | RESIDUAL LOAD TO BASIN | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | % of Total | (MGD) | (mg/l) | (lbs./day) | % of Total | (%) | (lbs./day) | (lbs./day) | % of Total |
| | | | | NITROGEN (as N) | | | | | | |
| Treated Sewage | | | | | | | | | | |
| South Tahoe PUD | 44,500 | 24.7 | 4.00 | 45 | 1,500 | 33.7 | 30 | 450 | 1,050 | 28.6 |
| Incline Village | 11,100 | 6.2 | 1.00 | 45 | 416 | 9.3 | 52 | 216 | 200 | 5.4 |
| North Tahoe PUD | 8,000 | 4.4 | 0.72 | 35 | 210 | 4.7 | 23 | 48 | 162 | 4.4 |
| Tahoe City | 1,700 | 1.0 | 0.15 | 45 | 56 | 1.3 | 100* | 56 | 0 | 0 |
| Subtotal | 65,300 | 36.3 | 5.87 | 45 | 2,182 | 49.0 | 35 | 770 | 1,412 | 38.4 |
| Untreated Sewage | 114,700 | 63.7 | | | 2,268 | 51.0 | 0 | 0 | 2,268 | 61.6 |
| Totals | 180,000 | 100.0 | | | 4,450 | 100.0 | 17.3 | 770 | 3,680 | 100.0 |
| | | | | PHOSPHORUS (as P) | | | | | | |
| Treated Sewage | | | | | | | | | | |
| South Tahoe PUD | 44,500 | | 4.00 | 8 | 267 | 33.6 | 98 | 262 | 5 | 1.0 |
| Incline Village | 11,100 | | 1.00 | 8 | 67 | 8.4 | 40 | 27 | 40 | 8.2 |
| North Tahoe PUD | 8,000 | | 0.72 | 6.8 | 41 | 5.2 | 16 | 7 | 34 | 7.0 |
| Tahoe City | 1,700 | | 0.15 | 8 | 10 | 1.3 | 100* | 10 | 0 | 0 |
| Subtotal | 65,300 | | 5.87 | 8 | 385 | 48.5 | 80 | 306 | 79 | 16.2 |
| Untreated Sewage | 114,700 | | | | 410 | 51.5 | 0 | 0 | 410 | 83.8 |
| Totals | 180,000 | | | | 795 | 100.0 | 38.5 | 306 | 489 | 100.0 |

* Tahoe City plant provides conventional secondary treatment; but all effluent drains out of Tahoe Basin.

NOTE: Tabulated results were extrapolated from data and information in "Consultants' Report".

Table II

### ESTIMATED SOURCES OF NUTRIENTS IN TAHOE BASIN

(Present - 1966 - 58,000 Average Annual Population)

| Source | | Total Sources (Before Treatment or Removal) | | Removal by Treatment or Disposal | Net to Basin (After Treatment or Removal) | |
|---|---|---|---|---|---|---|
| | | Pounds/Yr. | % of Total | % | Pounds/Yr. | % of Total |
| **Nitrogen (as N)** | | | | | | |
| Run-off | | 262,000 | 24.0 | 0 | 262,000 | 27.3 |
| Rain | | 222,000 | 20.4 | 0 | 222,000 | 23.2 |
| | Subtotal | 484,000 | 44.4 | 0 | 484,000 | 50.5 |
| Refuse | | 88,000 | 8.1 | 50 | 44,000 | 4.6 |
| Sewage | | 518,000 | 47.5 | 17 | 430,000 | 44.9 |
| | Subtotal | 606,000 | 55.6 | 22 | 474,000 | 49.5 |
| Total | | 1,090,000 | 100.0 | 12 | 958,000 | 100.0 |
| **Phosphorus (as P)** | | | | | | |
| Run-off | | 47,000 | 25.6 | 0 | 47,000 | 37.2 |
| Rain | | Trace | 0 | 0 | Trace | 0 |
| | Subtotal | 47,000 | 25.6 | 0 | 47,000 | 37.2 |
| Refuse | | 44,000 | 23.9 | 50 | 22,000 | 17.4 |
| Sewage | | 92,800 | 50.5 | 38 | 57,500 | 45.4 |
| | Subtotal | 136,800 | 74.4 | 42 | 79,500 | 62.8 |
| Total | | 183,800 | 100.0 | 31 | 126,500 | 100.0 |

NOTE: Tabulated results were extrapolated from data and information in "Consultants' Report".

Table III

### ESTIMATED SOURCES OF NUTRIENTS IN TAHOE BASIN

(Year 2010 - 254,000 Average Annual Population)

| | TOTAL SOURCES Before Treatment | | NET TO BASIN After Secondary Treatment | | | NET TO BASIN After Tertiary Treatment | | |
|---|---|---|---|---|---|---|---|---|
| | Lbs./Yr. | % of Total | % Reduction | Lbs./Yr. | % of Total | % Reduction | Lbs./Yr. | % of Total |
| **Nitrogen (as N)** | | | | | | | | |
| Run-off | 308,000 | 8.5 | 0 | 308,000 | 16.9 | 0 | 308,000 | 41.3 |
| Rain | 222,000 | 6.2 | 0 | 222,000 | 12.2 | 0 | 222,000 | 29.8 |
| Subtotal | 530,000 | 14.7 | 0 | 530,000 | 29.1 | 0 | 530,000 | 71.1 |
| Refuse | 383,000 | 10.7 | 100 | 0 | 0 | 100 | 0 | 0 |
| Sewage | 2,684,000 | 74.6 | 52 | 1,290,000 | 70.9 | 92 | 215,000 | 28.9 |
| Subtotal | 3,067,000 | 85.3 | 58 | 1,290,000 | 70.9 | 93 | 215,000 | 28.9 |
| Total | 3,597,000 | 100.0 | 50 | 1,820,000 | 100.0 | 80 | 745,000 | 100.0 |
| Sewage as % of Natural | (507%) | | | (244%) | | | (41%) | |
| **Phosphorus (as P)** | | | | | | | | |
| Run-off | 53,000 | 7.4 | 0 | 53,000 | 15.6 | 0 | 53,000 | 73.6 |
| Rain | Trace | 0 | 0 | Trace | 0 | 0 | Trace | 0 |
| Subtotal | 53,000 | 7.4 | 0 | 53,000 | 15.6 | 0 | 53,000 | 73.6 |
| Refuse | 191,000 | 26.5 | 100 | 0 | 0 | 100 | 0 | 26.4 |
| Sewage | 477,000 | 66.1 | 40 | 286,000 | 84.4 | 96 | 19,000 | 0 |
| Subtotal | 668,000 | 92.6 | 57 | 286,000 | 84.4 | 97 | 19,000 | 26.4 |
| Total | 721,000 | 100.0 | 53 | 339,000 | 100.0 | 90 | 72,000 | 100.0 |
| Sewage as % of Natural | (900%) | | | (540%) | | | (36%) | |

Note: Total Sources and Percent Removals according to "Consultants'" estimates.
Assuming that all garbage is exported out of Basin.

## TABLE IV

## NITROGEN, PHOSPHORUS, ALKALINITY AND pH OF LAKE TAHOE (1962)

| Station | Date | Depth m | Alkalinity as $CaCO_3$ mg/l | Nitrate N μg N/l | Soluble P μg P/l | pH |
|---|---|---|---|---|---|---|
| 1 | Apr 29 | 0 | 40 | 6.7 | 6.0 | 7.6 |
| | | 200 | 39 | 6.7 | 6.0 | 7.6 |
| | | 400 | 38 | 14.1 | 5.0 | 8.2 |
| | July 19 | 0 | 43 | 6.3 | 7.5 | 7.6 |
| | | 200 | 41 | 6.3 | 5.0 | 7.4 |
| | | 400 | 45 | 6.0 | 5.0 | 7.4 |
| 2 | May 5 | 0 | 40 | 6.7 | 7.5 | 8.0 |
| | | 200 | 41 | 6.7 | 4.0 | 7.9 |
| | | 400 | 41 | 6.7 | 4.0 | 7.9 |
| | July 17 | 0 | 43 | 6.3 | 6.0 | 7.6 |
| | | 200 | 43 | 7.0 | 5.0 | 7.5 |
| | | 400 | 45 | 13.0 | 25.0 | 7.3 |
| 3 | May 5 | 0 | 40 | 10.0 | 5.0 | 8.0 |
| | | 200 | 41 | 10.0 | 5.0 | 7.9 |
| | | 400 | 40 | 14.0 | 5.0 | 7.9 |
| | July 17 | 0 | 45 | 6.3 | 16.0 | 7.6 |
| | | 200 | 43 | 6.9 | 17.0 | 8.0 |
| | | 400 | 43 | 6.5 | 24.0 | 7.4 |
| 4 | Apr 29 | 0 | 41 | 6.7 | 5.0 | 8.3 |
| | | 250 | 40 | 6.7 | 4.0 | 8.3 |
| | | 500 | 40 | 16.0 | 5.0 | 8.2 |
| | July 17 | 0 | 44 | 6.3 | 4.0 | 7.5 |
| | | 250 | 43 | 6.3 | 9.0 | 7.6 |
| | | 500 | 43 | 6.9 | 7.5 | 7.3 |
| 5 | Apr 28 | 0 | 32 | 6.7 | 4.0 | 7.8 |
| | | 30 | 33 | 6.7 | 5.0 | 8.2 |
| | | 60 | 33 | 6.7 | 5.0 | 8.2 |

(Continued)

TABLE IV (Continued)

| Station | Date | Depth<br>m | Alkalinity<br>as $CaCO_3$<br>mg/1 | Nitrate<br>N<br>µg N/1 | Soluble<br>P<br>µg P/1 | pH |
|---|---|---|---|---|---|---|
| | July 19 | 0 | 29 | 6.3 | 7.5 | - |
| | | 30 | 33 | 6.9 | 5.0 | - |
| | | 60 | 33 | 7.0 | 12.0 | - |
| 6a | Apr 29 | 1 | 21 | 6.0 | 10.0 | 7.6 |
| | July 18 | 1 | 37 | 7.0 | 17.0 | 7.7 |
| 6b | Apr 29 | 2 | 27 | 4.5 | 7.5 | - |
| | July 18 | 2 | 42 | 6.9 | 4.0 | - |
| 6c | Apr 29 | 1 | 41 | 6.7 | 6.5 | 7.9 |
| | | 25 | 40 | 6.7 | 4.0 | 7.8 |
| | | 50 | 41 | 6.7 | 5.0 | 7.8 |
| | July 18 | 1 | 42 | 6.3 | 6.0 | 7.6 |
| | | 25 | 42 | 6.3 | 10.0 | 7.6 |
| | | 50 | 43 | 10.7 | 5.0 | 7.6 |
| 6d | Apr 29 | 3 | 41 | 7.5 | 5.0 | 7.8 |
| | July 18 | 3 | 43 | - | - | 7.7 |
| 6e | Apr 29 | 2 | 40 | 6.0 | 5.0 | 7.8 |
| | July 18 | 2 | 43 | 6.3 | 6.0 | 7.7 |
| | Apr 29 | 2 | - | 5.4 | 5.0 | - |
| | July 17 | 2 | 43 | 6.3 | 13.0 | 7.6 |
| 7a | Apr 29 | 1 | 41 | 5.4 | 9.0 | 7.8 |
| | July 17 | 1 | 43 | 6.3 | 15.0 | 7.6 |
| 7b | Apr 29 | 1 | 40 | 6.7 | 5.1 | 7.8 |
| | | 10 | 44 | 4.7 | 5.0 | 7.5 |
| | July 17 | 1 | 43 | 6.3 | 15.0 | 7.7 |
| | | 10 | 44 | 6.3 | 17.0 | 7.7 |
| 8a | Apr 30 | 1 | - | 4.5 | 4.0 | - |
| | July 18 | 1 | 44 | 6.5 | 17.0 | - |
| 8b | Apr 30 | 2 | - | 5.4 | 6.0 | - |
| | July 18 | 2 | 42 | 6.0 | 20.0 | 7.7 |

(Continued)

TABLE IV (Continued)

| Station | Date | Depth m | Alkalinity as $CaCO_3$ mg/1 | Nitrate N ug N/1 | Soluble P µg P/1 | pH |
|---|---|---|---|---|---|---|
| 8d | Apr 30 | 4 | - | 7.5 | 7.5 | - |
| | July 18 | 4 | 42 | 6.3 | 7.5 | 7.6 |
| 8e | Apr 30 | 1 | 41 | 5.4 | 4.0 | 7.9 |
| | | 8 | 41 | 4.7 | 5.0 | 7.9 |
| | | 16 | 42 | 3.3 | 5.0 | 8.3 |
| | July 18 | 1 | 42 | 6.3 | 4.0 | 7.6 |
| | | 8 | 43 | 6.0 | 5.0 | 7.5 |
| | | 16 | 43 | 6.8 | 7.5 | 7.6 |
| 8f | Apr 30 | 1.5 | - | 9.0 | 7.5 | - |
| | July 18 | 1.5 | 43 | 6.3 | 4.0 | 7.8 |
| 8g | Apr 30 | 2 | - | 5.4 | - | - |
| | July 18 | 2 | 43 | 6.9 | - | 7.6 |
| 9a | Apr 30 | 1 | - | 7.5 | 9.0 | - |
| | July 18 | 1 | 43 | 5.9 | 7.5 | 7.7 |
| 9b | Apr 30 | 4 | - | 7.8 | 6.0 | - |
| | July 18 | 4 | 43 | 6.0 | 7.5 | 7.6 |
| | | 8 | 42 | 6.5 | 7.5 | 7.6 |
| 9c | Apr 30 | 1 | 41 | 3.3 | 6.5 | 7.9 |
| | | 45 | 41 | 6.7 | 5.0 | 7.9 |
| | | 90 | 41 | 6.7 | 5.0 | 7.9 |
| | July 18 | 1 | 41 | 6.3 | 2.5 | 7.6 |
| | | 45 | 43 | 6.3 | 10.0 | 7.6 |
| | | 90 | 43 | - | 9.0 | 7.6 |
| 10 a | Apr 30 | 2 | - | 5.4 | 5.0 | - |
| | July 18 | 2 | 43 | 6.3 | 6.5 | 7.7 |
| 10b | Apr 30 | 2 | - | - | - | - |
| | July 18 | 2 | - | 6.3 | 7.5 | 7.6 |
| | | 100 | - | 6.3 | 6.0 | 7.6 |
| 10c | Apr 30 | 1 | 41 | 6.7 | 4.0 | 7.9 |
| | | 60 | 41 | 6.7 | 5.0 | 7.9 |

(Continued)

TABLE IV (Continued)

| Station | Date | Depth m | Alkalinity as $CaCO_3$ mg/l | Nitrate N µg N/l | Soluble P µg P/l | pH |
|---|---|---|---|---|---|---|
| | | 120 | 40 | 6.7 | 5.0 | 7.9 |
| | July 18 | 1 | 44 | 6.3 | 6.0 | 7.6 |
| | | 60 | 43 | 7.3 | 5.0 | 7.5 |
| | | 120 | 43 | 7.5 | 5.0 | 7.5 |
| 11a | May 5 | 1 | 44 | 6.0 | 8.0 | 7.8 |
| 11b | May 5 | 3 | 42 | 4.5 | 7.5 | 7.9 |
| | July 18 | 3 | 43 | 6.5 | 7.5 | 7.7 |
| 11c | May 5 | 1 | 42 | 7.5 | 10.0 | 7.9 |
| | | 9 | 41 | 5.4 | 9.0 | 7.9 |
| | July 18 | 1 | 43 | 6.0 | 5.0 | - |
| | | 9 | 43 | 6.0 | 6.0 | - |
| 11d | May 5 | 1 | 40 | 6.7 | 5.0 | 8.0 |
| | | 37 | 40 | 6.7 | 5.0 | 7.9 |
| | | 75 | 41 | 6.7 | 5.0 | 7.9 |
| | July 18 | 1 | 42 | 6.5 | 7.5 | 7.7 |
| | | 37 | 42 | 6.3 | 7.5 | 7.6 |
| | | 75 | 43 | 6.5 | 7.5 | 7.7 |
| 12 | May 6 | 1 | 38 | 6.7 | 7.5 | 7.8 |
| | July 19 | 1 | 44 | 5.2 | 6.0 | 7.6 |
| 13a | May 5 | 1 | 40 | 6.0 | 9.0 | 7.8 |
| | July 19 | 1 | 46 | 5.2 | 13.0 | 7.8 |
| 13b | May 5 | 1 | 40 | 6.0 | 10.0 | 7.9 |
| | July 19 | 1 | 43 | 5.2 | 10.0 | 7.6 |
| 13c | May 5 | 1 | 40 | 6.7 | 5.0 | 7.9 |
| | | 5 | 39 | 6.7 | 5.0 | 7.8 |
| | July 19 | 1 | 43 | 6.0 | 10.0 | 7.7 |
| | | 5 | 42 | 6.3 | 17.0 | 7.6 |
| 13d | May 5 | 1 | 40 | 8.4 | 5.0 | 7.7 |
| | July 19 | 1 | 42 | 5.4 | 10.0 | 7.9 |
| 13e | May 5 | 1 | 40 | 9.0 | 7.5 | 7.9 |
| | July 19 | 1 | 42 | 5.0 | 7.5 | 7.7 |

(Continued)

## TABLE IV(Continued)

### SUMMARY

| | N<br>µg N/l | P<br>µg P/l |
|---|---|---|
| Offshore (Stations 1 thru 4) | | |
| Number of Samples | | |
| May | 12 | 12 |
| July | 12 | 12 |
| Avg. Concentration | | |
| May | 9.2 | 5.1 |
| July | 8.0 | 10.9 |
| Nearshore (Stations 5 thru 13) | | |
| Number of Samples | | |
| May | 45 | 44 |
| July | 46 | 45 |
| Avg. Concentration | | |
| May | 6.4 | 6.1 |
| July | 6.4 | 8.7 |
| All Stations (1 thru 13) | | |
| Number of Samples | | |
| May | 57 | 56 |
| July | 58 | 57 |
| Avg. Concentration | | |
| May | 7.0 | 5.9 |
| July | 6.7 | 9.2 |

NOTE: Data from Table in Appendix "G" of "Consultants' Report".

TABLE V

CONCENTRATION OF PHYTOPLANKTON IN LAKE TAHOE (1962)

| Station | Collection Date | Org/ml |
|---|---|---|
| 1 | April 29 | 245 |
| | July 19 | 54 |
| 2 | May 5 | 127 |
| | July 17 | 26 |
| | Sept. 21 | 26 |
| | Sept. 13 | 66 |
| 3 | May 5 | 177 |
| | July 17 | 37 |
| 4 | April 29 | 212 |
| | July 17 | 13 |
| | Sept. 21 | 13 |
| 5 | April 28 | 76 |
| | July 19 | 33 |
| 6c | April 29 | 185 |
| | July 18 | 119 |
| 7 | April 29 | 1,260 |
| | July 17 | 3,890 |
| 7b | April 29 | 105 |
| | July 17 | 148 |
| 8e | April 30 | 118 |
| | July 18 | 68 |
| | Sept. 20 | 61 |
| 8g | April 30 | 167 |
| 9c | April 30 | 104 |
| | July 18 | 61 |
| 10c | April 30 | 195 |
| | July 18 | 58 |
| 11d | May 5 | 164 |
| | July 18 | 63 |
| 12 | May 6 | 262 |
| | July 19 | 578 |
| 13a | July 19 | 457 |

(Continued)

TABLE V (Continued)

| Station | Collection Date | Org/ml |
|---|---|---|
| 13b | July 19 | 1,400 |
| 13c | May 5 | 107 |
| | July 19 | 70 |
| | Sept. 21 | 29 |
| | Dec. 13 | 38 |
| 13d | July 19 | 794 |
| 13e | July 19 | 286 |

NOTE: Reproduction of Table 11-XL, pg 84 of the "Consultants' Report".

## TABLE VI

## JULY

## CHLOROPHYLL a CONCENTRATIONS IN LAKE TAHOE

| Sampling Area | Chlorophyll a mg/$m^3$ |
|---|---|
| 1 | 0.21 |
| 2 | 0.15 |
| 3 | 0.13 |
| 4 | 1.74 |
| 5 | 0.10 |
| 6 | 0.17 |
| 7 | 0.19 |
|  | 0.18 |
| 8 | 0.24 |
| 9 | 0.19 |
| 10 | 0.35 |
| 11 | 0.38 |
| 12 | 0.50 |
| 13a | 1.09 |
| 13b | 0.62 |
| 13c | 0.15 |
| 13d | 0.41 |
| 13e | 0.26 |

NOTE: Extracted from Table 11-XLIV pg 87, "Consultants' Report".

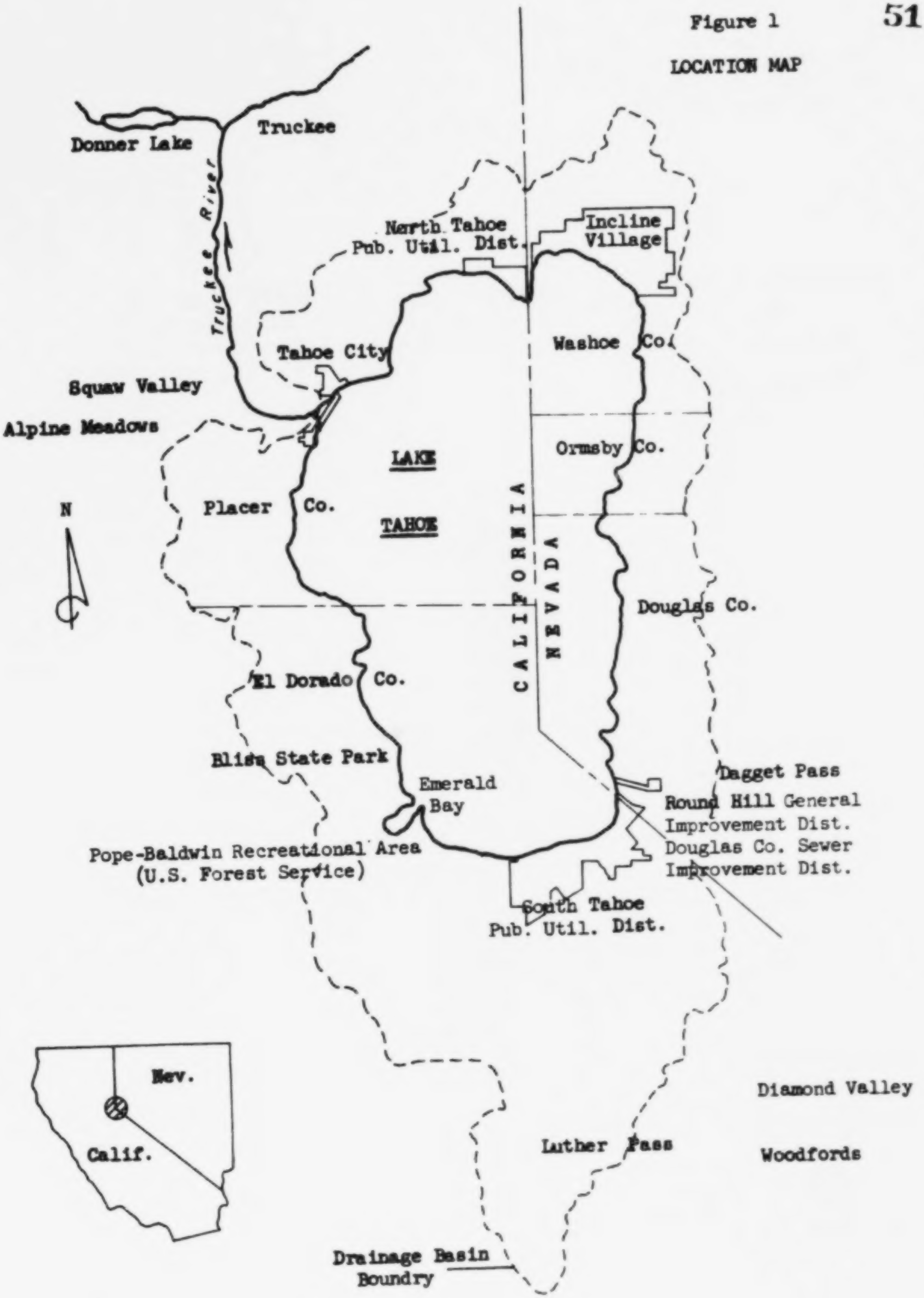
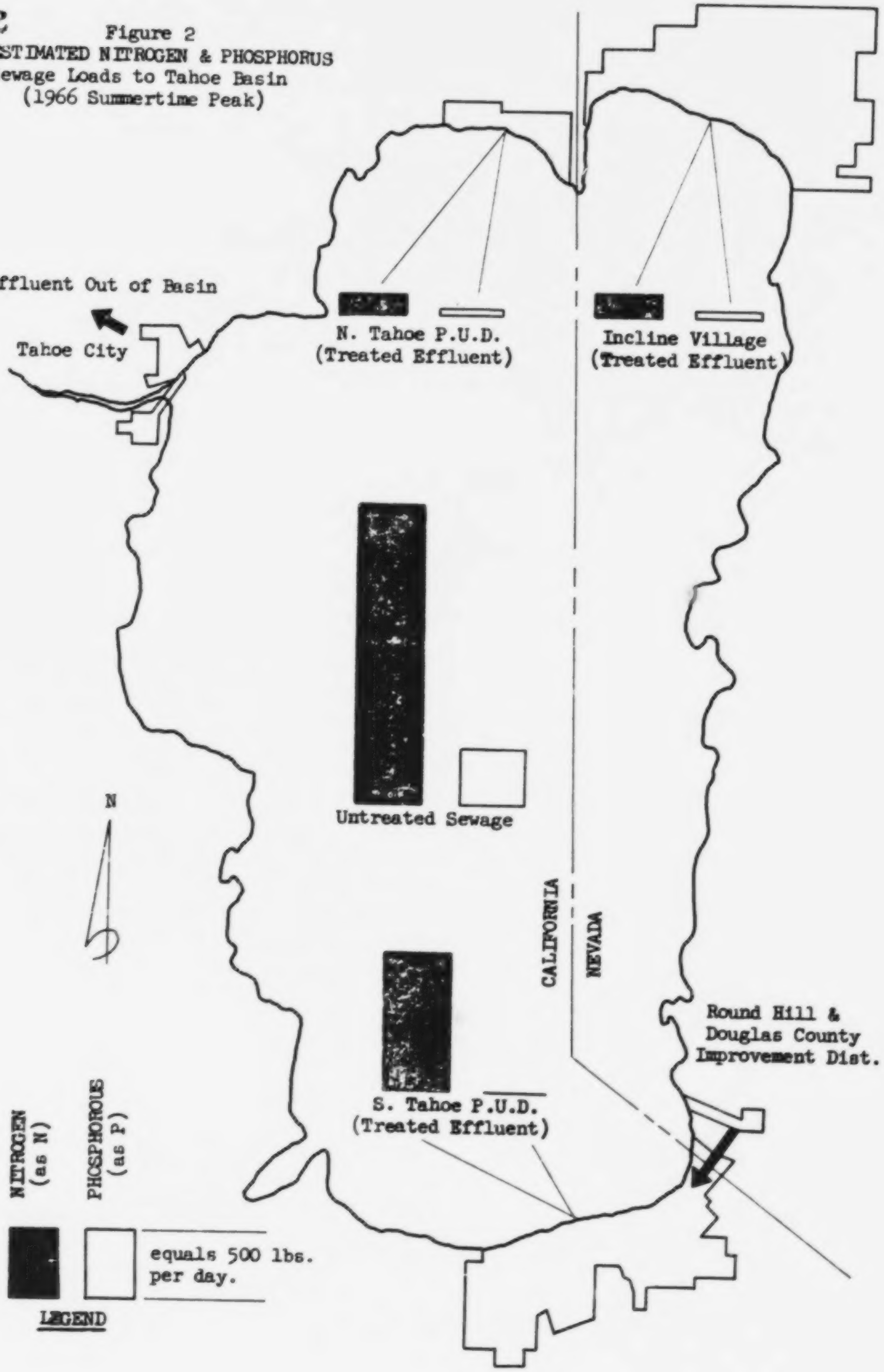


Figure 1

LOCATION MAP

Truckee
Donner Lake
Truckee River
North Tahoe
Pub. Util. Dist.
Incline
Village
Tahoe City
Washoe Co.
Squaw Valley
Alpine Meadows
Ormsby Co.
LAKE
TAHOE
N
Placer Co.
CALIFORNIA
NEVADA
Douglas Co.
El Dorado Co.
Bliss State Park
Emerald
Bay
Dagget Pass
Round Hill General
Improvement Dist.
Douglas Co. Sewer
Improvement Dist.
Pope-Baldwin Recreational Area
(U.S. Forest Service)
South Tahoe
Pub. Util. Dist.
Nev.
Calif.
Diamond Valley
Luther Pass
Woodfords
Drainage Basin
Boundry

Figure 2
ESTIMATED NITROGEN & PHOSPHORUS
Sewage Loads to Tahoe Basin
(1966 Summertime Peak)


Effluent Out of Basin
Tahoe City
N. Tahoe P.U.D.
(Treated Effluent)
Incline Village
(Treated Effluent)
Untreated Sewage
N
CALIFORNIA
NEVADA
Round Hill &
Douglas County
Improvement Dist.
S. Tahoe P.U.D.
(Treated Effluent)
NITROGEN
(as N)
PHOSPHOROUS
(as P)
equals 500 lbs.
per day.
LEGEND

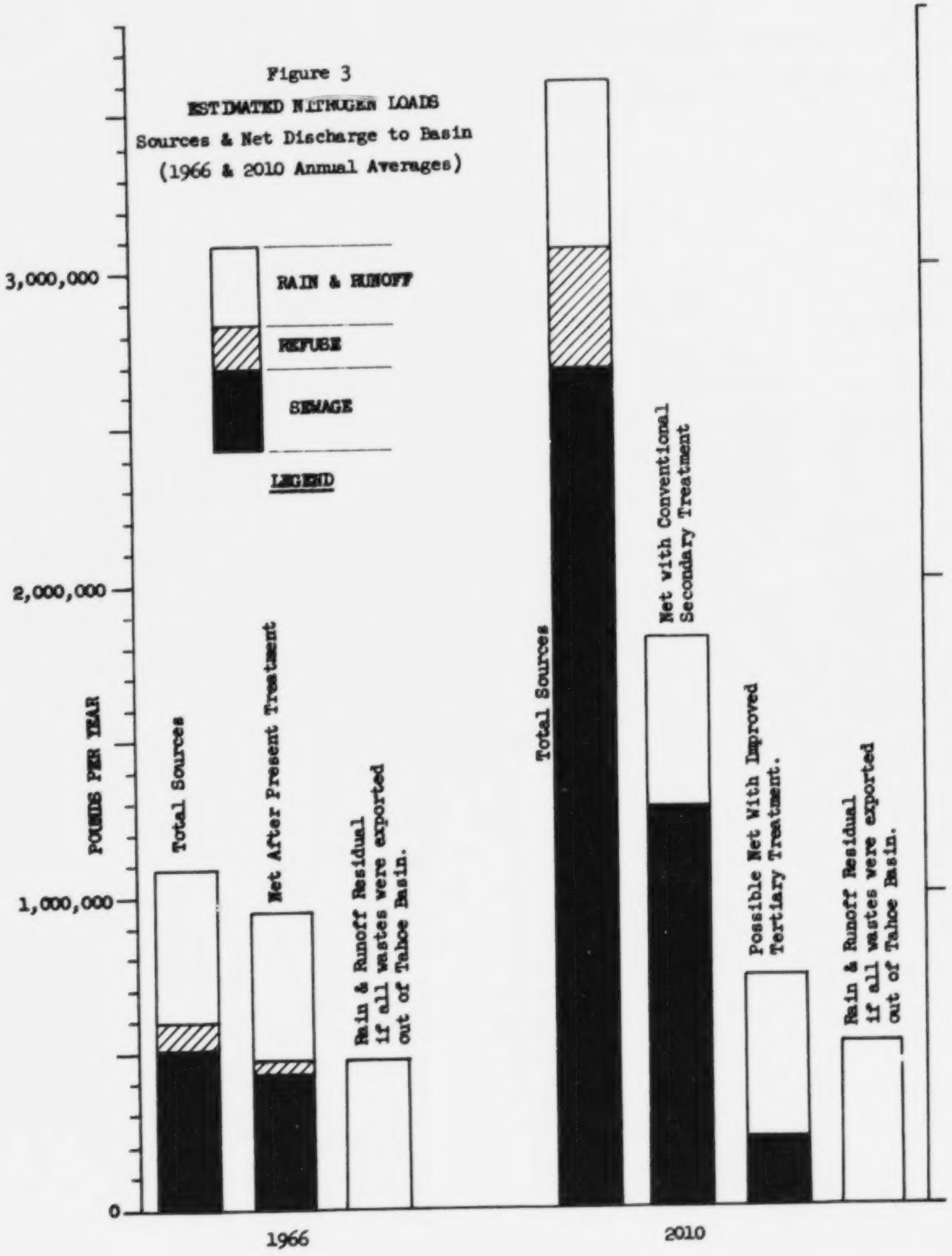


Figure 3

ESTIMATED NITROGEN LOADS

Sources & Net Discharge to Basin

(1966 & 2010 Annual Averages)

Figure 4

ESTIMATED PHOSPHORUS LOADS

Sources & Net Discharge to Basin
(1966 & 2010 Annual Averages)

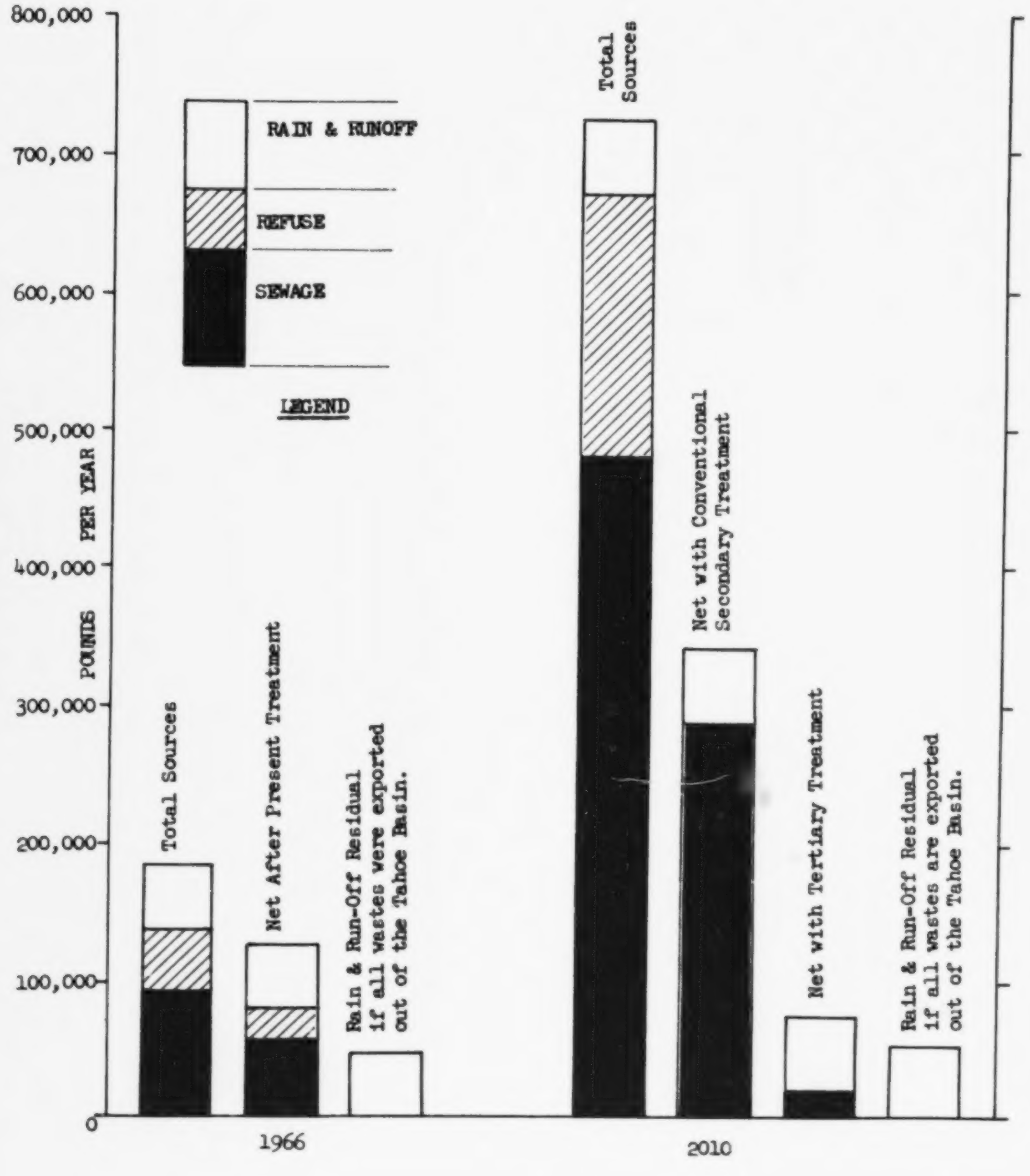


Figure 5

SAMPLING AREAS
IN LAKE TAHOE

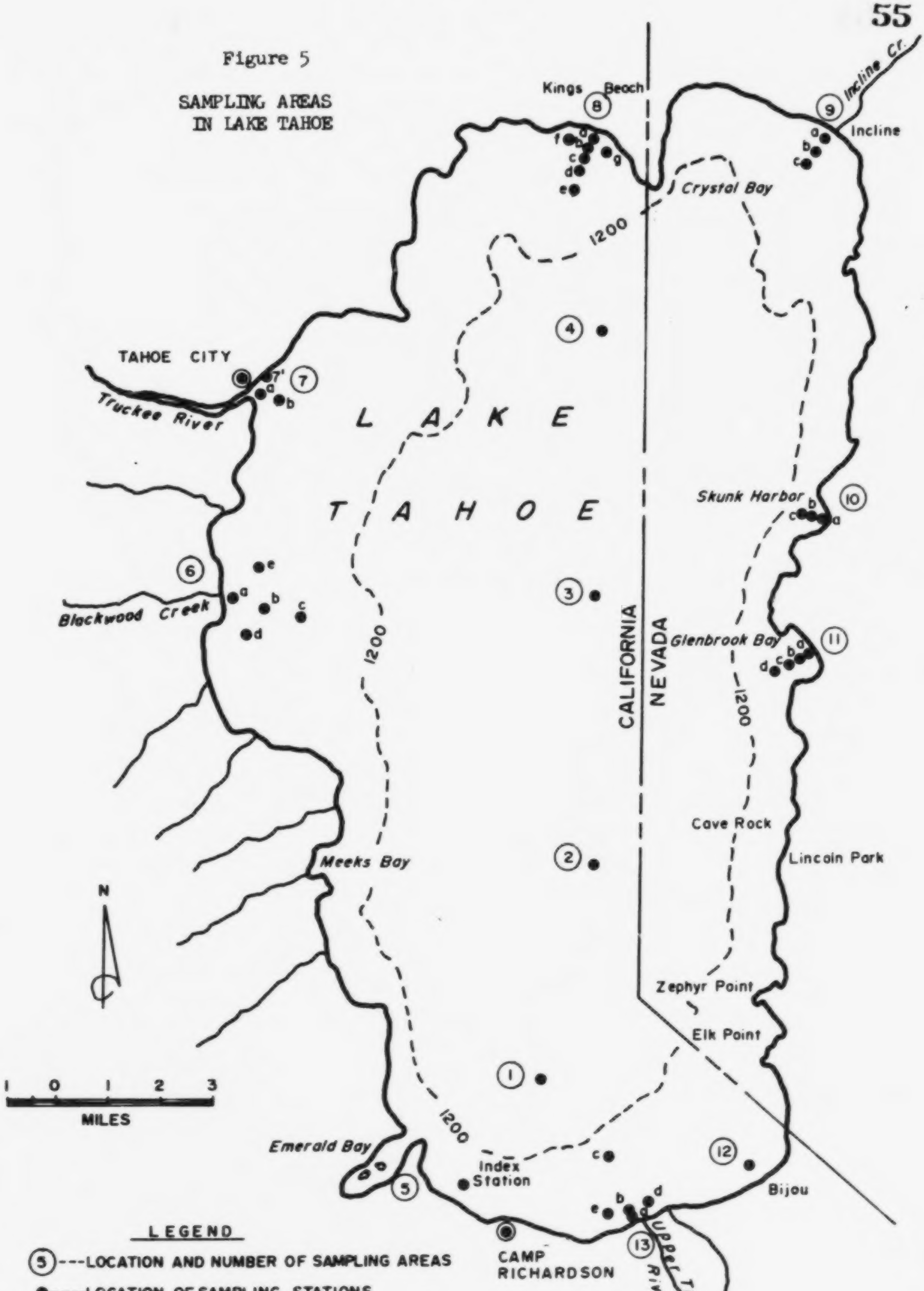
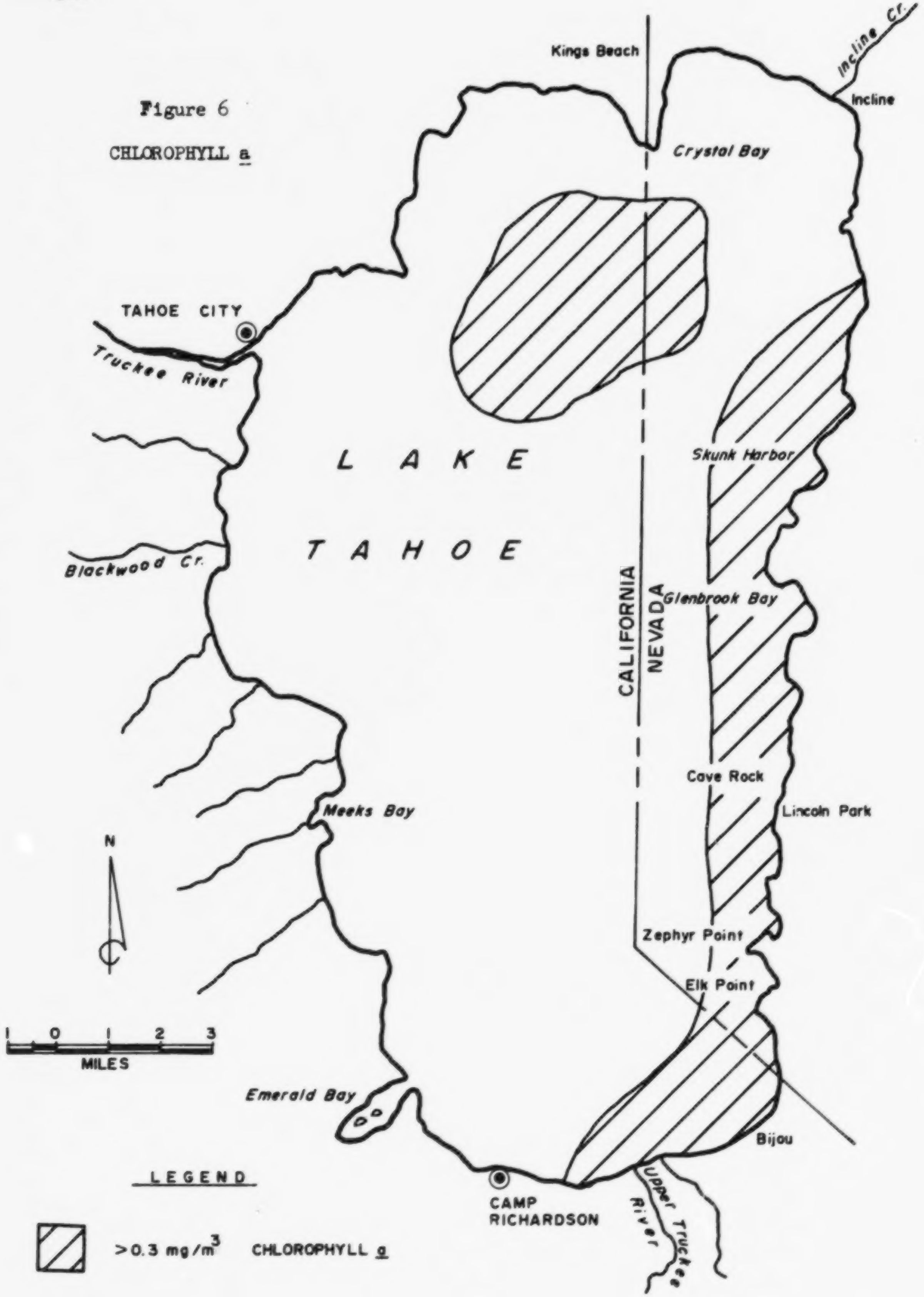

Kings Beach
8
Incline Cr.
9
Incline
Crystal Bay
1200
TAHOE CITY
7
7'
Truckee River
L A K E
T A H O E
4
Skunk Harbor
10
6
Blackwood Creek
3
CALIFORNIA
NEVADA
Glenbrook Bay
11
Cave Rock
Lincoln Park
Meeks Bay
2
N
Zephyr Point
Elk Point
1
1 0 1 2 3
MILES
Emerald Bay
12
Index Station
5
Bijou
13
CAMP RICHARDSON
Upper Truckee River
LEGEND
5 ---LOCATION AND NUMBER OF SAMPLING AREAS
●----LOCATION OF SAMPLING STATIONS
– – – 1200 FT. DEPTH CONTOUR

Figure 6

CHLOROPHYLL a


Kings Beach
Incline Cr.
Incline
Crystal Bay
TAHOE CITY
Truckee River
LAKE
TAHOE
Skunk Harbor
Blackwood Cr.
CALIFORNIA
NEVADA
Glenbrook Bay
Cave Rock
Lincoln Park
Meeks Bay
N
Zephyr Point
Elk Point
1 0 1 2 3
MILES
Emerald Bay
Bijou
LEGEND
CAMP RICHARDSON
Upper Truckee River
▨ >0.3 mg/m3 CHLOROPHYLL a

APPENDIX B

# LAKE TAHOE BASIN WATER QUALITY SURVEY

1961

by

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH
BUREAU OF SANITARY ENGINEERING

# LAKE TAHOE BASIN WATER QUALITY SURVEY -- 1961

Periods of Extensive Field Sampling and Laboratory Analyses:

PHASE I (Early Summer) June 19 to July 8, Inclusive
PHASE II (Late Summer ) August 21 to September 9, Inclusive

Lake Tahoe South Shore from Heavenly Valley

State of California
Department of Public Health
Bureau of Sanitary Engineering

## ORGANIZATION

### STATE OF CALIFORNIA

### DEPARTMENT OF PUBLIC HEALTH

| | |
|---|---|
| E. A. Reinke | Chief, Bureau of Sanitary Engineering |
| Paul C. Ward | Supervising Engineer |
| Gilbert W. Fraga | Project Engineer |

---

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| Homer Vaughn | Lahontan Regional Water Pollution Control Board |
| F. A. Piglowski | U.S.P.H.S. Region IX<br>San Francisco |
| Laboratory Work by Sanitation and Radiation Laboratory | A. E. Greenberg, Chief |

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Placer County Health Department

Nevada County Health Department

Lahontan Regional Water Pollution Control Board

Lake Tahoe Area Council

South Tahoe Public Utility District

North Tahoe Public Utility District

## TABLE OF CONTENTS

Page Number

Organization and Project Staff . . . . . . . iii

Acknowledgment . . . . . . . . . . . iv

Table of Contents . . . . . . . . . . v

List of Figures . . . . . . . . . . vii

List of Tables . . . . . . . . . . ix

Preface to Summary and Conclusions . . . . . . xii

Summary . . . . . . . . . . . . xiii

Conclusions . . . . . . . . . . . xviii

INTRODUCTION . . . . . . . . . . . 1

OBJECTIVE . . . . . . . . . . . . 3

ORGANIZATION AND METHODS OF STUDY . . . . . . 4

HISTORY OF PREVIOUS STUDIES . . . . . . . 8

FINDINGS . . . . . . . . . . . . 10

- I Lake Water Sampling Program . . . . . 10
  - A. Lake Tahoe . . . . . . . . 11
  - B. Fallen Leaf Lake . . . . . . . 27
  - C. Donner Lake . . . . . . . . 30
  - D. Beach Studies . . . . . . . . 33
  - E. Intake and Depth Studies . . . . . 53

TABLE OF CONTENTS (continued)

Page Number

II Well, Stream and Spring Sampling Program . . 60

A. Upper Truckee River and Bijou Creek Sampling Program . . . . . . 60

B. Lower Truckee River Sampling Program . . . . . . 71

C. Sector Studies . . . . . . . . 81

III Assessment of Sewage Disposal Practices . . 101

A. Community Systems . . . . . . 101

B. Individual Systems . . . . . . . 113

C. Septic Tank Pumping Practices . . . 119

APPENDIX . . . . . . . . . . . . 121

* * * * * * * * * * * * *

## LIST OF FIGURES

| Figure | Title | Page Number |
|---|---|---|
| 1. | Diagram of the Zobell Device and the Modified Assembly . . . . . | 6 |
| 2. | Chart of North Shore Sampling Stations at Lake Tahoe . . . . . . . . | 12 |
| 3. | Chart of West Shore Sampling Stations at Lake Tahoe . . . . . . . . | 13 |
| 4. | Chart of South Shore Sampling Stations at Lake Tahoe . . . . . . . . | 14 |
| 5. | North Shore Data - Median Values of Turbidity and Coliform Densities vs. Sampling Stations on Lake Tahoe . . . . . . | 15 |
| 6. | West Shore Data - Median Values of Turbidity and Coliform Densities vs. Lake Tahoe Sampling Stations . . . . . . . | 16 |
| 7. | South Shore Data - Median Values of Turbidity and Coliform Densities vs. Lake Tahoe Sampling Stations . . . . . . . | 17 |
| 8. | Sketch of Fallen Leaf Lake Showing Sampling Stations . . . . . | 28 |
| 9. | Sketch of Donner Lake Showing Sampling Stations . . . . . | 31 |
| 10. | Sketch of South Tahoe Shoreline Showing Special Beach Sampling Stations . | 35 |
| 11. | Sketch of Meeks Bay Showing Sampling Stations . . . . . | 51 |
| 12. | Bacteriological Quality vs. Water Depth in Lake Tahoe . . . . . . . . | 55 |

64

LIST OF FIGURES (continued)

| Figure | Title | Page Number |
|---|---|---|
| 13. | Coliform Bacteria at Surface and Depth in Areas of Different Use . . . . | 56 |
| 14. | Chart of Upper Truckee River and Bijou Creek Showing Sampling Stations . . . . | 61 |
| 15. | Chart of Lower Truckee River Showing Sampling Stations . . . . | 72 |
| 16. | Chart of Lake Tahoe Showing Sector Sampling Zones . . . | 82 |

* * * * * * * * * * * *

LIST OF TABLES

| Table Number | Title | Page Number |
|---|---|---|
| I | Maximum Plankton Density at Lake Tahoe Sampling Stations . . | 18 |
| II | Results of Organic Analyses of Samples Collected from Lake Tahoe . . . . | 20 |
| III | Results of Organic Analyses of Samples Collected from Fallen Leaf Lake . . | 29 |
| IV | Results of Analyses from Samples Collected at Donner Lake . . . . . | 32 |
| V | Special Beach Studies - Description of Sampling Stations at Popular Beaches . . . . . | 36 |
| VI | Special Beach Studies - Results of Analyses from Samples Collected at Seven Beach Stations . . | 37 |
| VII | Results of Bacteriological Analyses Median Coliform Densities at Popular Beaches . . . . . . | 46 |
| VIII | Special Beach Studies - Morning vs. Afternoon Median Values of Turbidity and Chlorides . . . . | 48 |
| IX | Results of Sanitary Survey Investigations at Meeks Bay . . . | 52 |
| X | Variation of Bacteriological Quality vs. Zones of Depth - All Stations on Lake Tahoe | 54 |
| XI | Bacteriological Quality vs. Offshore Distance | 58 |

LIST OF TABLES (continued)

| Table Number | Title | Page Number |
|---|---|---|
| XII | Bacteriological Quality at Water Supply Intakes - Surface and Bottom Comparisons . . . . . . . . . | 58 |
| XIII | Bacteriological Quality at Water Supply Intakes - Water Over Intakes vs. Water Further Offshore . . . | 59 |
| XIV | Upper Truckee River Sampling Data . . . | 62 |
| XV | Bijou Creek Sampling Data . . . . . | 67 |
| XVI | Lower Truckee River Sampling Data . . . | 74 |
| XVII | Squaw Valley Sampling Data . . . . | 77 |
| XVIII | Sample Analyses of Wells and Springs in the Donner-Truckee Area . . . | 78 |
| XIX | Sampling Results of Sector Studies Wells, Streams and Springs Sampling Program . . . . . . . | 83 |
| XX | Sampling Results - Truckee Sanitary District Sewage Treatment Plant . . | 102 |
| XXI | Sampling Results - Squaw Valley Olympic System Sewage Treatment Plant . . . | 104 |
| XXII | Sampling Results - Tahoe City P.U.D. Sewage Treatment Plant . . . . . | 105 |
| XXIII | Sampling Results - North Tahoe P.U.D. Sewage Treatment Plant . . . . . | 106 |
| XXIV | Chemical Analyses of Samples Collected from Oxidation Pond Monitoring Wells South Tahoe P.U.D. Sewage Treatment Plant . . . . . . . . . . | 108 |

LIST OF TABLES (continued)

| Table Number | Title | Page Number |
|---|---|---|
| XXV | ABS, Chloride and Nitrate Sampling Data from Oxidation Pond Monitoring Wells South Tahoe P.U.D. Sewage Treatment Plant . . . . . . . . . . . | 110 |
| XXVI | Miscellaneous Sampling in the Environs of the South Tahoe P.U.D. Sewage Treatment Plant . . . . . . | 111 |
| XXVII | Summary of Individual Sewage Disposal Practices Reported by Sector Arrangement . . . . . . | 114 |

* * * * * * * * * * * *

## PREFACE TO SUMMARY AND CONCLUSIONS

The Lake Tahoe Basin has been experiencing very rapid increases in population growth, and in commercial and land development in recent years. Current summertime populations are estimated at greater than 60,000 persons, and the ultimate population is predicted for 200,000 persons during peak week ends in the recreation season. With this growth in population the problem of disposal of increasing volumes of sewage flow becomes urgent. Sewage overflows and failures of household and community collection and treatment facilities in the area have not been uncommon. Overflows from community facilities have in a few instances reached surface waters.

An estimated 41 percent of the total summertime population is served domestic water pumped from Lake Tahoe. A great many other public and private water systems in the Tahoe Basin derive drinking water supplies from streams, springs and wells. The lake waters are used extensively for water-contact sports, such as swimming, bathing and water skiing.

The beauty of the lakes in the Basin is legendary. The shades of green and blue of their clear waters would be affected by any activity that resulted in the discharge of silt or organic matter to these lakes or to their tributary streams. Complaints of turbidity induced by construction practices on the watershed have become increasingly frequent and the public has demanded improved conditions.

Responsible persons have alleged that the Basin's lakes and streams were threatened by pollution, or were being polluted by sewage. This survey was therefore planned to determine to what extent, if any, the present waste disposal practices were affecting the quality of surface and well waters in the Basin. Investigation of the effects on lake water quality by activities in heavily populated areas at resorts and public beaches was also undertaken.

The scope of the study included a plan to compare the levels of water quality in the Basin before, and during the impact of the summertime recreational population. It was anticipated that the levels of measurable water quality might be degraded to some extent during, or immediately after the height of the summer season. It was also planned that the survey data in this report would serve as a "base line" of 1961 water conditions in the Tahoe Basin, and that they could be used for comparison with data obtained in future water quality studies.

The reader should note that the summer season of study in 1961 followed several years of subnormal rainfall and runoff in the Basin. The level of Lake Tahoe was about 6 feet below normal, and the lower ground water tables throughout the Basin were undoubtedly beneficial to the generally successful operation of individual household and community soil absorption sewage disposal systems.

The reader should note also that a limited series of samples were collected, and all were from the California area of the Tahoe Basin. The frequency and period of sampling was adjusted to best satisfy the basic objectives of this study under the limitations of manpower and of laboratory facilities. The sampling methods and laboratory procedures employed gave results that, at best, show only the conditions existing at the precise times samples were collected. Sporadic events of pollution could easily be missed in such a program.

## SUMMARY

### Lake Waters

From the data collected there is no evidence that sewage was reaching the waters of Lake Tahoe, of Fallen Leaf Lake, and of Donner Lake in sufficient quantities to be readily detectable by laboratory measurement.

Median values plotted for both coliform bacteria density and turbidity at sampling stations along the shores of Lake Tahoe show there is usually a relationship in the plot of these two measurements; that is, when coliform densities were high at certain stations, it was usually found that turbidity in these waters were also higher than normal. This relationship was very pronounced at stations along the south shore of the lake during both the early and late summer phases of sampling.

The data has shown that, in general, water quality conditions were better during the late summer phase of sampling than found earlier. It had been anticipated that a higher level of water quality might have been found earlier in the summer, before the impact of the heavy summertime population and concomitant sewage flows. This was not the case, however, It was found that the discharge of streams tributary to Lake Tahoe was mostly accountable for the early summer increases in turbidity and bacterial densities. Heavy boating, water skiing and bathing activities at popular beaches and marinas tend to raise coliform bacteria and turbidity levels. Recreational activities were greatest during mid-August and early September.

There were only a few instances when detectable ABS (alkylbenzene-sulfonate) was found. (ABS is a common component of synthetic detergent.) Other analyses on samples collected concurrently for indices of sewage pollution were negative. Some evidence suggests that marine fuels spilled in the water may have resulted in the "positive" reaction found in most of the samples tested for ABS.

Tests for nitrogen compounds, phosphates and chlorides from samples collected from all lakes in the Basin were in very low concentrations. Plankton concentrations measured in all samples collected were similarly quite low.

No areas were found which had sufficient plankton growth to be noticeable to observers along the shoreline or from a boat. The most dense growths of plankton ranged from 1,000 to 5,000 organisms per milliliter, and these densities were generally found in marinas and in shallow beach waters along the south shore of Lake Tahoe. The higher plankton densities were found in areas of warmer waters.

Organic analyses (carbon adsorption) of samples collected from water supply intakes in Lake Tahoe and Fallen Leaf Lake, had chloroform extract portions that were well below the recommended limit for drinking water.

The sampling data collected from studies on Fallen Leaf Lake did not show conclusively that sewage was reaching the lake. Some relatively high coliform densities were found along the west shore of the lake near the mouth of Glen Alpine Creek and offshore from the Stanford Sierra Camp resort, but the other indices, ABS, chlorides, and nitrates were negative. Persons familiar with sanitation problems at the lake told of several cases when resort and cabin sewage disposal systems had failed during previous seasons. Much of the developed lands around the lake are in steep, rocky terrain, and it is difficult to develop adequate sewage disposal systems. It is probable that many of the individual sewage disposal systems at the lake might fail and overflow to surface waters during wetter seasons.

At times during the early summer phase of sampling on Fallen Leaf Lake, heavy accumulations of yellow pine pollen were observed in waters in windward coves. The pollen was heavy at times directly over one of the shallow community water supply intakes.

From the data collected at Donner Lake, there was no evidence that sewage was reaching surface or ground waters in sufficient quantities to be readily detectable by laboratory measurement.

## Beach Studies

Data obtained from early sampling showed evidences of water quality degradation at or near popular beaches and marinas, especially along the south shores of Lake Tahoe. In an effort to find some reason for the higher coliform, turbidity, and chloride values in these areas, additional samples were collected. The data gave some evidence that the higher densities of coliform and turbidity were created by bathers and by heavy boating activities at the beaches, especially during the peak of activities in the afternoon. The cause of what appeared to be minor increase in chloride levels in the beach areas was not determined. All other tests made for indices of sewage pollution were negative. Bacteriological samples collected from the beach stations were analyzed for both coliform and fecal coliform organisms, and the results indicated that the coliform types normally associated with soils were present in much greater numbers than the coliform types predominant in fecal wastes.

Additional sampling at Meeks Bay also showed that local stream discharges, heavy marina activity, and channel dredging can contribute largely to local increases in coliform bacteria and turbidity. Bathing activities alone do not seem to increase these values to a great extent, unless the beach adjoins very shallow, confined waters.

## Intake and Depth Studies

These special studies were concerned with finding some insight to the distribution of coliform bacteria at various lake depths, and with increments of distance offshore. Additional bacteriological samples were collected by boat over some of the major water supply intakes around Lake Tahoe.

The sampling data obtained suggests that surface waters contain higher coliform bacteria concentrations than do the deeper waters. The data were divided also into categories of use such as: areas of little use; boating areas; swimming areas; and places of stream discharge. The data give evidence that boating activities, and discharges of streams create higher levels of coliform bacteria, and that the densities are greatest in surface waters at these places.

Data comparing the bacteriological quality vs. increments of distance offshore at prominent water supply intakes indicated there is no apparent relationship, i.e., the bacteriological concentration did not necessarily diminish at increasing distances offshore.

## Wells, Streams and Springs

The study of wells, streams and springs in the Tahoe Basin was accomplished in a program separate from the lake water sampling because of operational convenience.

A summary of all the data indicates that levels of water quality are improved somewhat later in the summer season. The data suggest that greater stream flow and animal contamination in runoff waters in the early summer months might be accountable. Well waters are unaffected by this trend.

Additional sampling effort was provided in the Upper Truckee River watershed, and along Bijou Creek, because results obtained in the lake water sampling program showed a deterioration in water quality at the mouth of these streams during the early summer phase of sampling.

The high level of turbidity found in the Upper Truckee River in the early summer was traced to a construction site at the Highway 50 bridge crossing. Excavations were being dewatered by several pumps and combined discharges contained heavy silt concentrations. Large numbers of cattle on the watershed contribute greatly to the bacterial population in the Truckee River.

Localized increases in coliform bacteria, chlorides and ABS in Trout Creek were traced to embankment seepage at the South Tahoe P.U.D. sewage treatment plant. Some foaming was noted in the flow of Heavenly Valley Creek a short distance downstream from the plant property. These concentrations diminished progressively downstream from the plant as dilution was afforded.

Later in the season, during the Labor Day week end, sewage effluent overflowed from the spray irrigation field operated by the South Tahoe P.U.D. sewage treatment plant, and the effluent reached some of the neighboring meadows and streams. The seepage and the overflow were the only discharges on the watershed that were reaching the waters of the Upper Truckee River or its tributaries.

The data results and observations along Bijou Creek show that the water quality in this stream was being degraded. Although no direct sewage discharges were found, the stream was unsightly and foul-smelling in places, and considerable quantities of trash and oily wastes were found along its banks. The waters were yellowish in appearance, and one dead fish was found. The sampling results show that the discharge of Bijou Creek was affecting the quality of water in the immediate area in Lake Tahoe.

## Lower Truckee River

From the data collected there is no evidence that sewage was reaching the waters of the Lower Truckee River in sufficient quantities to be readily detectable by laboratory measurement. Road repair work being done at Squaw, and at Prosser Creeks was accountable for localized turbidity increases. Chloride levels were usually low throughout the river, and they ranged from 1.0 to 2.5 mg/l. Exceptions were found at Squaw Creek however, where the chlorides were 12.4 mg/l below the Olympic sewage treatment plant and 4.4 mg/l at the mouth of the Valley. However, all other test indices for sewage pollution were negative. The higher levels of chloride in Squaw Creek suggest that the effect of the effluent percolating through natural gravels into the stream is insignificant.

## Sector Studies

The study of surface and well waters (excepting lake waters) in the Basin was divided arbitrarily into geographical zones or "sectors" for reporting convenience. During these investigations routine searches were made for indications of failing sewage disposal systems, especially of the individual soil-absorption type.

From the data collected in sampling wells, streams and springs in the Basin, there were only two instances in which evidence was found that sewage was reaching streams or wells in sufficient quantity to be detectable by laboratory measurement. One such incident was summarized earlier as the seepage of sewage from an embankment at the South Tahoe Public Utility District's sewage treatment plant. In this case, test indices for sewage pollution were traced from the plant flow at least a mile downstream on Trout Creek. The other case involved degradation of waters at a well in Al Tahoe, presumably by an abandoned, nearby laundry waste sump. At this well the chloride analysis showed 9.0 mg/l, ABS was 0.3 and 0.12 mg/l, while coliform bacteria was 21 MPN per 100 ml. No other well waters showed any evidence of sewage pollution by the testing procedures used.

## Assessment of Sewage Disposal Practices

In this survey particular attention was devoted to investigating what effects the effluents from community sewage disposal systems were having on the quality of surface or well waters. No attempt was made to appraise treatment methods, plant works, or their efficiencies. Attention was also given to those sewage collection systems and pumping stations which have been known to fail on occasion in the past. Individual sewage disposal systems at private dwellings, resorts, and summer camps were investigated in sector areas, especially in neighborhoods which have had failures in previous seasons.

There are seven major community sewage disposal systems in the Tahoe Basin, and in only one case was sewage found overflowing from a community plant to nearby waters in quantities detectable by laboratory measurement. This incident was summarized earlier as the seepage of sewage flow from the embankment at the South Tahoe P.U.D. sewage treatment plant. No failures in the sewage pumping stations were observed or reported.

Motel operators and others in Tahoe Vista complained of strong sewage odors occurring, especially late in the evening. Searches made throughout the unsewered neighborhood revealed one failing septic tank system which serves a roadside inn. The North Tahoe Public Utility District's sewage treatment plant is situated in the foothills to the north of the community and it was found later that one of the percolation ponds at this plant had turned septic and was creating offensive odors.

Only seven cases of individual-type sewage disposal system failures were located during the survey. In no instances were any of the overflows reaching nearby surface or well waters.

A small flow of liquid was noticed flowing continually down Stateline Boulevard along the California-Nevada State Boundary in June. High coliform bacteria and positive results for ABS gave evidence that the flow might have been of sewage origin. The flow was traced to a fissure in the street. A broken sewage force main might have been accountable for this flow.

Septic tank pumping practices were investigated and no instances were found in which these operations were affecting water quality conditions in the Tahoe Basin.

## CONCLUSIONS

It is concluded that conditions of water quality in the wells, lakes and streams of Lake Tahoe Basin during the period of study in 1961, were not being affected to any great extent by current sewage disposal practices. A few individual household soil absorption systems were failing, but overflows were not reaching nearby surface and well waters.

Seepage, high in chlorides and containing ABS, was found draining beyond the property of the South Tahoe Public Utility District's sewage treatment plant and this flow was reaching Heavenly Valley Creek. Laboratory data did not suggest that the seepage was exerting a measurable effect that continued as far as Lake Tahoe.

Sources of domestic water supply were free of adverse effects from waste disposal, except one well which was near an abandoned sump formerly used for laundry waste disposal.

The water quality survey made in the Lake Tahoe Basin in 1961 followed a number of years of subnormal precipitation in the area. The level of Lake Tahoe was 6 feet below normal, and ground water tables throughout the Basin were undoubtedly lowered. The relatively dry ground conditions may help to account for the successful operation of a great many household soil absorption systems and the community disposal facilities using land disposal. For these reasons, it is essential the study of water quality conditions in the Basin should be repeated at the earliest possible time following a season of heavy precipitation and runoff. Particularly, studies should be planned to include comprehensive measurements of water quality and hydrology during the times of snowmelt in the sewage disposal areas and when the tributary streams are at peak flow.

Dredging of channels in mariras, road construction above streams, pavement and road drainage, and the dewatering of excavations into nearby streams and all similar activities which cause unnecessary turbidity in surface waters, should be planned or engineered in such a manner to minimize their effect.

The incident of the Labor Day overflow of sewage effluent from the South Tahoe Public Utility District's disposal facilities into streams and meadows in the watershed demonstrates the problems that can result from projects which though carefully planned are not completed and not properly operated.

The agencies primarily responsible for sewage disposal in the rapidly developing Tahoe Basin should develop and carry out long-range programs for the provision of completely adequate sewage collection, treatment and disposal facilities which are necessary to protect the quality of waters in the Lake Tahoe Basin. Adequate facilities should be provided well in advance of critical need.

## INTRODUCTION

The Lake Tahoe Basin Water Quality Survey was planned and conducted to determine the effects on water quality within the Tahoe Basin by the influences of increased population, recreational activities, and commercial development. A great many interested groups, both public and private, are striving to preserve the Basin as one of California's greatest scenic and recreational resources. The purity and clarity of the waters of Lake Tahoe and its tributary streams are legendary, and the quality of its waters may well be the Basin's greatest resource. It is important, then, that efforts be made to assess, periodically, the quality of these waters to determine if the impact of greater populations and human activities is threatening to pollute, contaminate, or render unsightly the famous waters of the Tahoe Basin.

Tahoe is facing an almost alarming rate of population and land development increases. A profound problem of planning and control exists when one considers that Lake Tahoe and the surrounding Basin are divided by two states and six counties, and by the factor of recreational attraction which creates an enormous transient population.

The Lake Tahoe area has been undergoing a rapid change from a rural to an urbanized community. Current summertime populations are estimated at greater than 60,000 persons, and ultimate population estimates predict 200,000 persons. This rapid population growth, with concomitant increases in sewage flows, could create an urgent situation which would result in the impairment of Tahoe water quality if controls are not developed quickly. The obvious solution to this problem is to plan and provide for safe and effective collection, treatment and disposal for sewage wastes in the Lake Tahoe Basin.

The sanitary quality of the waters of Lake Tahoe must be maintained at a high standard both for water-contact recreation and for domestic drinking water purposes.

At present there are nine large public water supply systems in California which pump water from Lake Tahoe. Only a few chlorinate for minimal treatment. About 13,000 persons are served by these lake intakes. Eighteen smaller systems also pump from the lake. Six large water systems in the Basin derive water supplies from wells and streams exclusively, and these serve a summertime population of about 17,500 persons. There are from 20 to 30 smaller systems which obtain water supplies from wells, springs and streams. These figures indicate that about 41 percent of the total summertime population is served water pumped from Lake Tahoe. The importance is then apparent that both surface and ground waters must be maintained in the best possible sanitary quality consistent with domestic water supply standards.

This water quality study is probably the first extensive survey of its kind ever performed on the Tahoe Basin. Aside from its principal objective in determining whether present sewage disposal practices are endangering the quality of the Basin waters, the survey data might profitably be used as a "base line" of 1961 water conditions from which future comparisons might be made. Charges were made in 1960 that signs of pollution already had been observed in Lake Tahoe. This survey was motivated largely by these claims, and its objective was to include whether the charges were, or were not valid.

The survey was divided into two study phases. Equal periods of three weeks were devoted both to early and late summer sampling and investigations. With this plan it was anticipated that a comparison of results could be made from data collected before and during the peak summertime population.

It is important to consider that the summer season of study in 1961 followed several years of subnormal runoff in the Basin. The level of Lake Tahoe was about 6 feet below normal, and the low ground water tables throughout the Basin were conducive to the satisfactory operation of sewage disposal systems using soil absorption methods. If the ground water tables had been normal or above, it is possible that a greater number of the absorption systems might have failed. It would be possible then that some might overflow into lakes or streams.

## OBJECTIVE

The objective of the Lake Tahoe Basin Water Quality Survey was to determine to what extent, if any, the present waste disposal practices affect the quality of surface and underground waters as sources of domestic water supply. The effects of heavily used bathing areas at resorts and public beaches on the quality of the lake waters were also investigated.

Included in the scope of the objective was a plan to compare the qualities of these waters during both early and late summer study phases. It was anticipated that perhaps the levels of measurable water quality might be degraded to a larger extent during the late summer. This anticipates that the recreational population would be greatest in August and September, and presumes that some sewage disposal systems might have become overloaded, with resulting overflows to nearby surface waters.

## ORGANIZATION AND METHODS OF STUDY

A general description of the survey organization and the methods of study employed are presented here. Specific details of sampling procedure and equipment used are described in the introduction to each study program in the body of the report.

The Lake Tahoe Basin Water Quality Survey was divided into two, three-week periods of study. The first phase of study was made during the early summer period from June 19 to July 8, inclusive. The second phase was made during the late summer from August 21 to September 9, inclusive.

Each study phase was then divided into equal ten-day periods of concentrated study; first, in the southern region of the Tahoe Basin, and then in the northern region. Studies were not made on the State of Nevada side of Lake Tahoe.

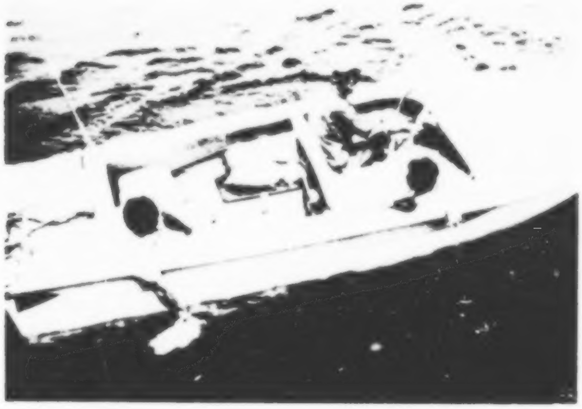
When the ten days of study were completed in the southern zone, the entire field crew, along with the mobile laboratory facilities, moved to quarters at the north shore of the lake for the remaining ten days. Members of the sampling team were assigned special tasks such as boat sampling, special beach and resort studies, and assessment of sewage disposal practices.

The data obtained from the sampling of wells, streams and springs in the Tahoe Basin were divided arbitrarily into geographical sectors for convenience of reporting. A chart indicating the division of these sectors is shown in Figure 16, page 82.

Several photographs follow which show some typical scenes during the field study.

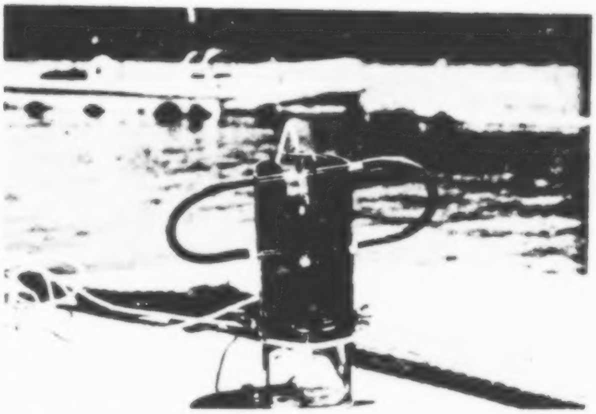
As the study developed in the early summer phase, preliminary results obtained implicated needs for special sampling efforts in some areas. For example, higher levels of turbidity and coliform concentrations were found in Lake Tahoe during Phase I in an area extending from the mouth of the Upper Truckee River eastward along the south shore toward Bijou. To assess the causes of this condition, concentrated studies were made along the Upper Truckee River and its tributary creeks, at Tahoe Keys and at Bijou Creek. These investigations were repeated during Phase II for comparison. Water quality studies were also made along the Lower Truckee River, at Squaw Valley, and in the Donner-Truckee region of the Basin.

It was found, too, that levels of turbidity and coliform bacteria were higher in the shallow waters at resort beaches and marinas. Special sampling techniques were developed in an attempt to



Routine sampling on Lake Tahoe. Team member in bow is collecting a depth sample, while crewman in stern brings up a plankton sample.

The "Lee" modification of the Zobell depth sampler. The messenger weight rides the suspension cord and breaks the sterilized glass tubing at the top of the instrument. The two rubber arms flip out, and the sample is automatically collected from the desired depth.



DEPARTMENT OF PUBLIC HEALTH

The mobile laboratory trailer in operation at the yard of the North Tahoe P.U.D. sewage treatment plant.

Photo taken near the mouth of the Upper Truckee River shows a small herd of the hundreds of cattle which graze on this watershed. Sampling results give evidence that the cattle contribute greatly to the bacteriological quality of the surface waters in this watershed.

explain these occurrences. Details of these techniques and results they yielded are described in the chapter entitled "Beach Studies".

Since many thousands of persons are supplied domestic water from lake intakes at Tahoe, additional emphasis was devoted to bacteriological sampling at the larger intakes in an attempt to find whether coliform densities diminish at greater offshore distances and depths.

To accomplish these ends, special depth sampling techniques were used in the lakes under study. At each established station, bacteriological samples were collected both from the surface and near the bottom. In order to obtain a true sample from any desired depth, a modified Zobell[1] sampling device was assembled prior to the survey. In operation, the device is lowered by cord to the desired depth, and then a brass messenger is released; the weight descends along the cord, striking and breaking a sterilized glass tube which is connected to the sample bottle. The sample is then drawn by air displacement.

Figure 1 shows drawings of both the original Zobell device and the modified "Lee" design used in this study. The consistency of bacteriological results yielded indicated that the sampler was operating properly.

The tests and analyses routinely made throughout the survey included serial dilution coliform tests, fecal coliform, temperature, turbidity, synthetic detergent expressed as alkyl-benzene-sulfonate (ABS), chloride, nitrite, nitrate, phosphate, plankton count and identification, and organic analyses (carbon filter adsorption). All of the above analyses were performed in the field laboratory, with the exception of phosphate, plankton and carbon filter determinations. These were made at the parent sanitation laboratory in Berkeley.

The routine coliform test was made to assess the bacteriological quality of the waters, to make comparisons with drinking water standards, and to serve as an index to inadequate sewage disposal practices in both surface and well waters. The fecal coliform test was used occasionally as a device to differentiate between organisms of animal and soil origins.

The presence of ABS was used extensively during the survey as an index of pollution. The chloride test was used for the same purpose, but to a lesser degree. Nitrite and nitrate analyses were made to assess the degree and age of organic pollution. These tests, together with the phosphate analysis, were made to assess the growth potential that waters would have for nuisance organisms. Plankton densities were determined at many stations.

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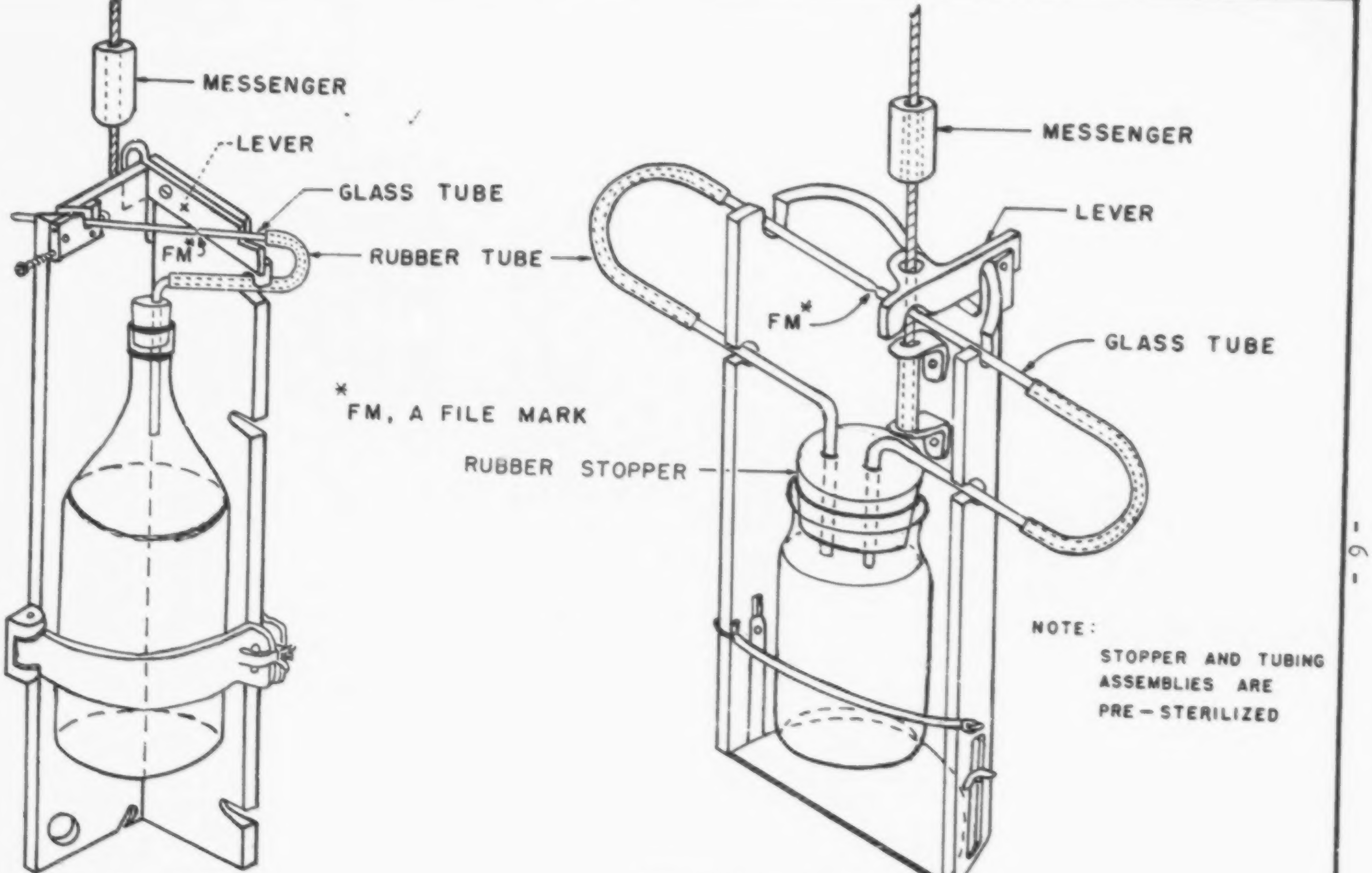
[1] Zobell Device - See Figure 3, page 30 in the text Marine Microbiology by Claude E. Zobell, 1946.


MESSENGER
LEVER
GLASS TUBE
FM*
RUBBER TUBE
MESSENGER
LEVER
FM*
GLASS TUBE
RUBBER STOPPER
NOTE:
STOPPER AND TUBING
ASSEMBLIES ARE
PRE-STERILIZED

*FM, A FILE MARK

ZOBELL BACTERIOLOGICAL
WATER SAMPLER

MODIFIED SAMPLER

FIGURE I
DIAGRAM OF THE ZOBELL DEVICE
AND THE MODIFIED ASSEMBLY
BSE 1961

Organic analyses (carbon adsorption samples) were collected from representative water supply intakes at Lake Tahoe and at Fallen Leaf Lake.

Dissolved oxygen (DO) samples were not collected from the lake waters as all previous data collected for many years have shown that the DO was at or near complete saturation, even at considerable depths. It was noted that some investigators had recorded the dissolved oxygen in Tahoe waters to be in ranges from 73 to 85 percent saturation, but had neglected to correct for the lower solubility of oxygen at high altitude. Dissolved oxygen saturation tables are usually based upon a standard sea level atmospheric pressure of 760 mm of mercury and the atmospheric pressure at Tahoe is about 600 mm. A much higher degree of saturation is shown when the correction is applied. Depressions in dissolved oxygen could not be expected since no gross discharge of sewage was directly entering surface waters of the Tahoe Basin.

As stated earlier, the objective of the survey was to find to what extent, if any, the present waste disposal practices were affecting the quality of the Basin waters. Attention was given primarily to the study of any travel of sewage effluents from treatment plants, and to the collection of appropriate samples in downstream areas to assess whether the disposal practices were measurably affecting water quality. A number of roving investigations were made in both suspected, and in random neighborhoods throughout the Basin in an effort to locate and assess failing, individual-type sewage disposal systems. These investigations were often made in company with personnel from the local health departments.

At times of severe storm conditions on the lake, or when boat mechanical difficulties arose, samples were collected by the team operating from a truck. At these times samples were collected at popular beaches, from marinas, and from prominent piers around the shores. Notations were made on the data sheets indicating those samples which were collected on foot.

Close attention was given to the making of immediate investigations whenever any member of the survey party received complaints or comments concerning sewage overflows, odor nuisances, or reports of unsightly waters. A majority of the complaints received were concerned with such happenings during former seasons.

## HISTORY OF PREVIOUS STUDIES

Some previous studies have been made of the sanitary and water quality conditions at Lake Tahoe in the past, and there have been numerous reports compiled by consulting engineers and by State and Federal agencies which have described studies of both water quality conditions and planning problems. The very rapid rate of development in the Basin has created many new problems in a short span of years and the need was apparent for immediate action in bringing the levels of engineering knowledge up to date.

In view of this, the U. S. Public Health Service, the Nevada and California State Health Departments, the Lahontan Regional Water Pollution Control Board of California, and all other state and county agencies charged with water quality activities, held a conference to discuss Lake Tahoe water quality problems. The conference concluded that a comprehensive study and a program of action be initiated without delay to plan for the protection of Basin water quality.

A compilation was made of earlier data and information as a preliminary step toward this goal. This report has been completed and it bears the title, "Compilation of Information Related to Water Quality of Lake Tahoe". Copies may be obtained from the Division of Water Supply and Pollution Control, USPHS, DHEW, Region IX, San Francisco.

The compilation shows recent information on economic development, water uses, waste disposal and water quality. The appendices show many references and outlines of current studies being made on Lake Tahoe in which this survey is mentioned. It includes a summary which shows an evaluation of existing data, and the following conclusions are made:

"1. Presently the quality of water in Lake Tahoe is excellent usually exceeding the U. S. Public Health Service Drinking water Standards without treatment;

2. Based on information gathered for this report, the methods of sewage treatment presently used seem to be adequate at this time in protecting the lake from pollution;

3. Accelerating land development and population growth in the Basin are threats to the preservation of the existing quality of water in the lake. Comprehensive and integrated land-use planning is essential. Special attention should be given to the future problems associated with the collection, treatment and disposal of sewage and other wastes; and

4. Presently available information is not sufficient for planning purposes. Existing data on future populations, water uses, feasible methods for the treatment and disposal of wastes, and fundamental

hydrology and limnology of the lake are too meager to provide a basis for planning and action to protect the water quality in the Lake Tahoe Basin in the future."

No attempt is made here to review in detail the findings of earlier studies of water quality conditions, other than to recall that the waters of the Tahoe Basin have been of very high quality in the past. In a few instances there have been sewage disposal failures and overflows which did threaten the water quality of Lake Tahoe or its tributaries.

# FINDINGS

## I. LAKE WATER SAMPLING PROGRAM

### GENERAL

A team of two was assigned to collect samples by boat at selected sampling stations on Lake Tahoe, Fallen Leaf Lake, and Donner Lake. During each of the study phases (early summer and late summer) the boat sampling crew operated for approximately ten days in south Lake Tahoe, followed by ten days of sampling in the north lake regions. The California shoreline of Lake Tahoe, from Crystal Bay on the north shore to Stateline on the south shore, was divided into two sections for sampling purposes at a point about one-half mile northwest of Chamber's Lodge on the west shore. Thus, each phase was equally divided between the "South Run" and the "North Run" sections.

The "lake water" sampling stations were chosen on the basis of four considerations from which meaningful data might be obtained: (1) sampling at popular beaches; (2) sampling in regions where there was considerable development and activity; (3) sampling directly over public water supply lake intakes; and (4) sampling at the mouth of major streams which discharge to the lakes under study. "Background" sampling stations were also selected on the three lakes. These stations were at considerable distances offshore to minimize any effects of shoreline water quality changes.

Where water depths permitted, all samples were collected at a standard distance of 50 yards offshore. Collections were made at greater offshore distances whenever the boat operation might have threatened the safety of swimmers. At times when a boat could not be operated because of mechanical problems, samples were collected from shore, on foot. Samples collected in this manner are noted on the data sheets. Figures appear in the text which show the sampling stations at the lakes under study.

Special sampling effort was made at popular beaches, particularly along the south shore of Lake Tahoe. Comparison samples were collected at these beaches early in the morning and in the mid-afternoon, to assess whether bathing and swimming activities might account for increases of turbidity and coliform bacteria densities. This is discussed in detail under the chapter, "Beach Studies".

Other studies were made to compare coliform bacteria densities from samples collected from the surface, near the bottom, or at increments of depth. Bacteriological samples were collected at some of the major water supply intakes in Lake Tahoe; collections were made at these stations both at increments of depth and at progressively greater distances offshore from the intakes. The purpose of this study was to determine to what degree concentrations of coliform bacteria vary with depth and distance offshore.

As soon as the sampling run was completed each day, the chemical and iced bacteriological samples were delivered by courier to the mobile laboratory with the least possible delay.

## A. LAKE TAHOE

During the twenty continuous days devoted to each study phase, ten days of study were accomplished in the north lake and south lake regions, respectively. The direction of progression along the sampling stations was varied in order to achieve knowledge of water quality conditions at each station at times both early in the day and during the mid-afternoon. Data comments were made describing recreational activities, water-contact sports, and the numbers of bathers at popular beaches. Several photographs follow which show scenes typical of the sampling program on Lake Tahoe.

"Carbon filter" sampling devices were installed at several of the larger domestic water supply intakes. These were placed at (1) Brockway Water Company, (2) Tahoe City Public Utility District, (3) Tahoe Cedars Water Company, and (4) Connolly's Resort. Daily inspections of the "filters" were made to assure proper operation and correct rate of flow.

The three figures which follow show the locations of the selected sampling stations along the shores of Lake Tahoe. Station No. 13-1/2 was selected about two miles northeast of Rubicon Point, in deep water, as a "Background" station. It was expected that samples collected here would be beyond any possible influence of sewage disposal. The data sheets which show the results of the lake water sampling programs are attached in the Appendix of this report.

The coliform densities and the turbidity analyses are summarized jointly because it was suspected that a relationship existed. The median values for each were plotted as ordinates opposite the sampling stations. These curves appear in Figures 5, 6, and 7. The spacing of the stations plotted in these figures is in proportion to their actual land distance intervals.

For the DATA SHEETS of the LAKE WATER SAMPLING PROGRAM - LAKE TAHOE

see the APPENDIX of this report

# Lake Tahoe Sampling Program

Organic analysis (carbon filter) sampling device in operation. Sample flow is being collected from an intake in Lake Tahoe. The instrument is set up in the kitchen of a popular resort.

In a color photograph, the accumulation of thick, yellow pine pollen scum is very evident on the shores of Emerald Bay. The heaviest pine pollen concentrations were seen in late June.

The intake mouth of this large water supply intake in Lake Tahoe is constructed of butt-joined steel drums with cut-away screened sections. The intake, which is 500 feet offshore, is in only six feet of water depth.

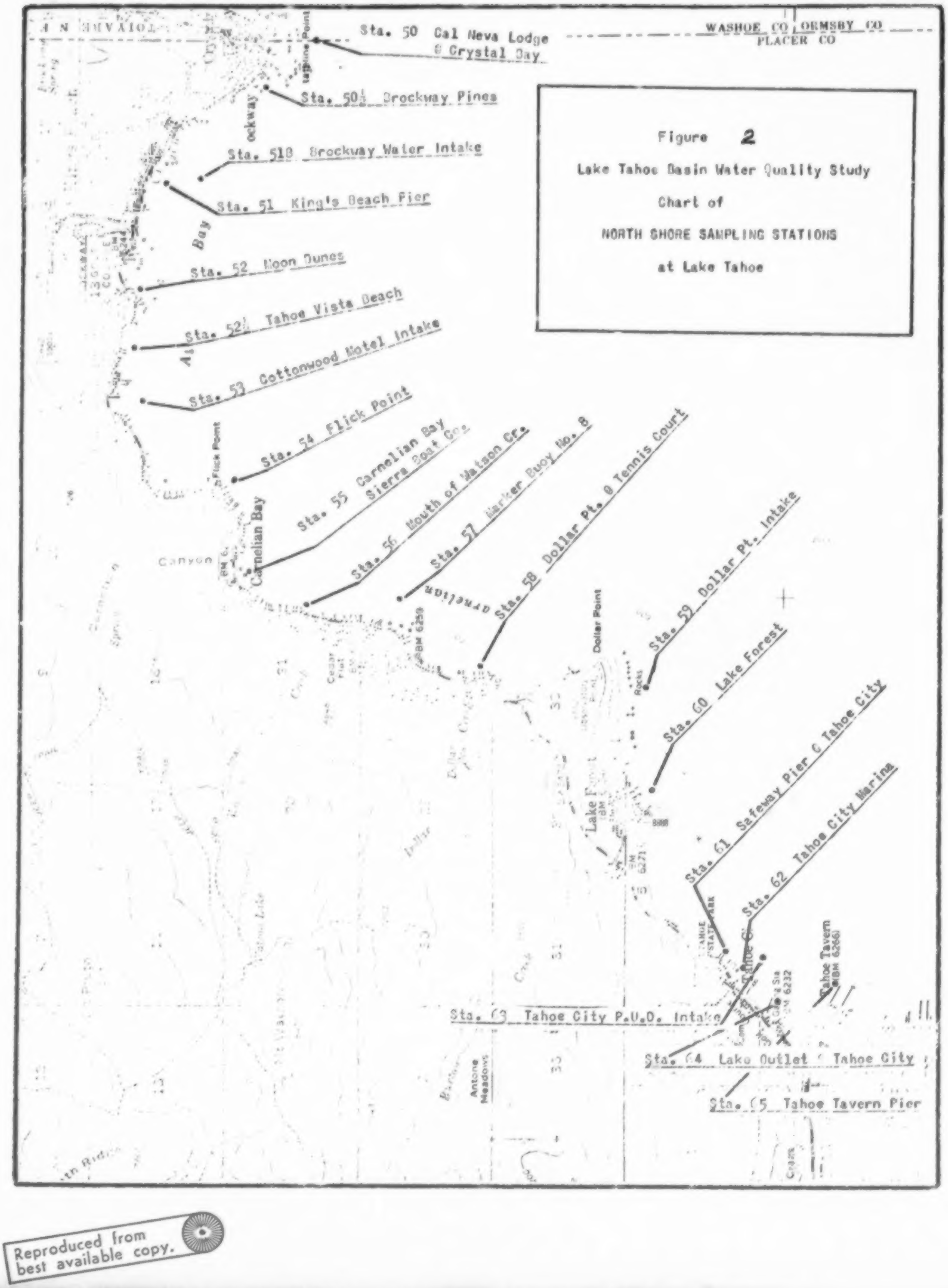


Figure 2

Lake Tahoe Basin Water Quality Study

Chart of

NORTH SHORE SAMPLING STATIONS

at Lake Tahoe

WASHOE CO
ORMSBY CO
PLACER CO
Sta. 50 Cal Neva Lodge @ Crystal Bay
Sta. 50½ Brockway Pines
Sta. 51B Brockway Water Intake
Sta. 51 King's Beach Pier
Sta. 52 Moon Dunes
Sta. 52½ Tahoe Vista Beach
Sta. 53 Cottonwood Motel Intake
Sta. 54 Flick Point
Sta. 55 Carnelian Bay Sierra Boat Co.
Sta. 56 Mouth of Watson Cr.
Sta. 57 Marker Buoy No. 8
Sta. 58 Dollar Pt. @ Tennis Court
Sta. 59 Dollar Pt. Intake
Sta. 60 Lake Forest
Sta. 61 Safeway Pier @ Tahoe City
Sta. 62 Tahoe City Marina
Sta. 63 Tahoe City P.U.D. Intake
Sta. 64 Lake Outlet @ Tahoe City
Sta. 65 Tahoe Tavern Pier
Brockway
Bay
Flick Point
Carnelian Bay
Canyon
Dollar Point
Rocks
Lake Forest
Tahoe Tavern
Antone Meadows

Reproduced from best available copy.

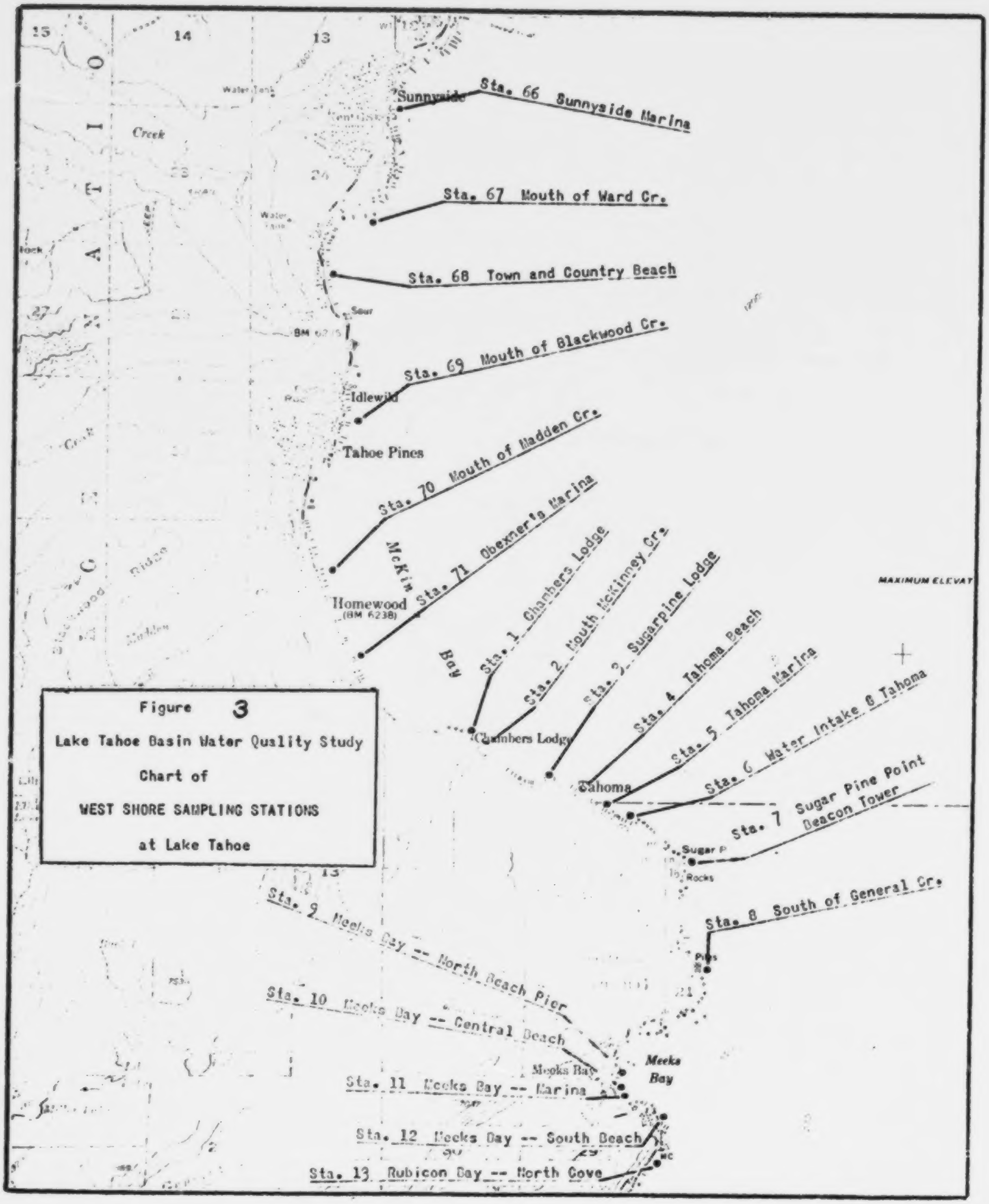

Sta. 66 Sunnyside Marina
Sunnyside
Sta. 67 Mouth of Ward Cr.
Sta. 68 Town and Country Beach
Sta. 69 Mouth of Blackwood Cr.
Idlewild
Tahoe Pines
Sta. 70 Mouth of Madden Cr.
Sta. 71 Obexner's Marina
Homewood
(BM 6238)
McKinney
Bay
Sta. 1 Chambers Lodge
Sta. 2 Mouth McKinney Cr.
Sta. 3 Sugarpine Lodge
Sta. 4 Tahoma Beach
Sta. 5 Tahoma Marina
Sta. 6 Water Intake @ Tahoma
Sta. 7 Sugar Pine Point Beacon Tower
Chambers Lodge
Tahoma
Sugar P
Rocks
Sta. 8 South of General Cr.
Sta. 9 Meeks Bay -- North Beach Pier
Sta. 10 Meeks Bay -- Central Beach
Sta. 11 Meeks Bay -- Marina
Sta. 12 Meeks Bay -- South Beach
Sta. 13 Rubicon Bay -- North Cove
Meeks Bay
Meeks Bay
MAXIMUM ELEVAT
Creek
Water Tank
Ridge
15
14
13

Figure 3

Lake Tahoe Basin Water Quality Study

Chart of

WEST SHORE SAMPLING STATIONS

at Lake Tahoe

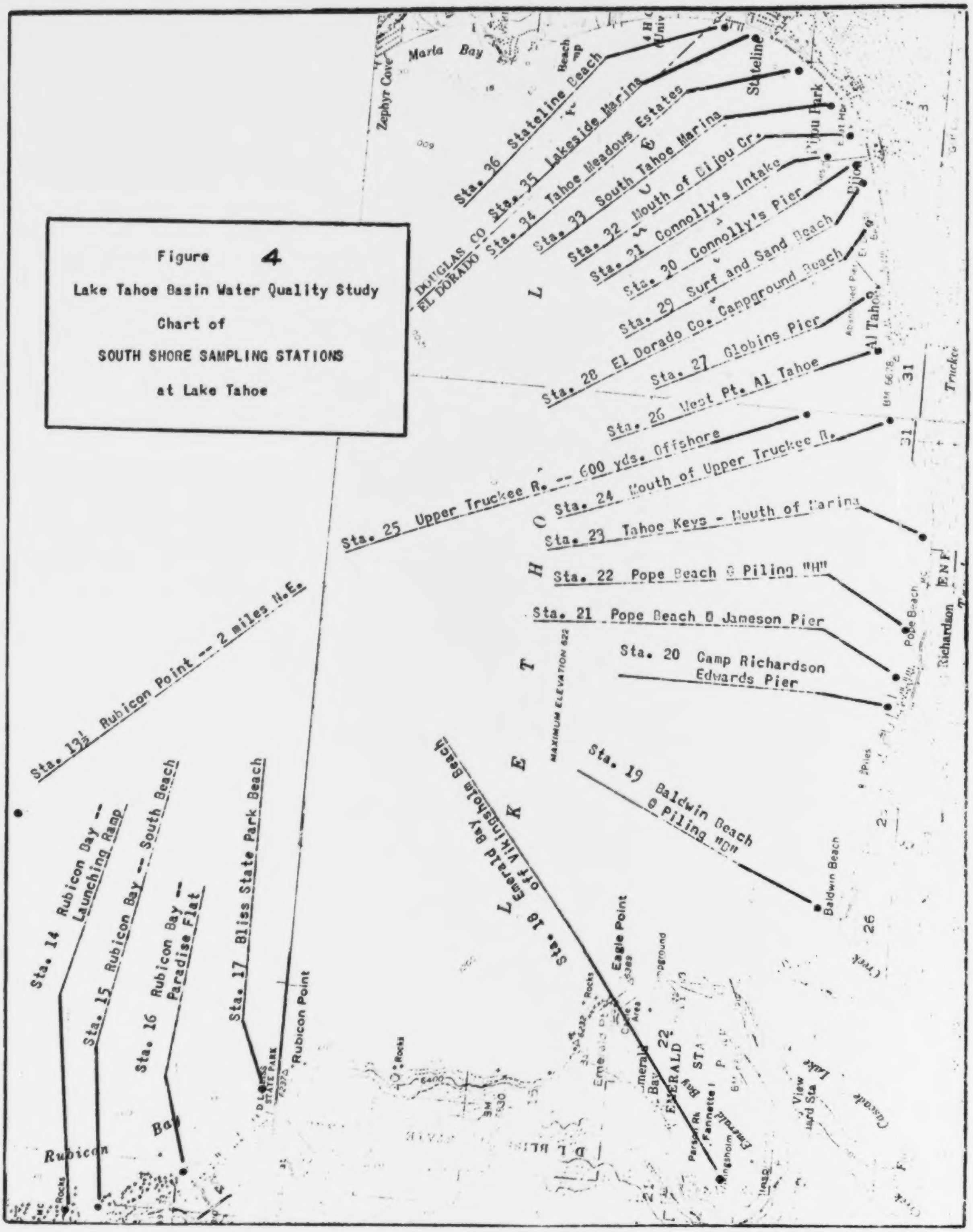


Figure 4

Lake Tahoe Basin Water Quality Study

Chart of

SOUTH SHORE SAMPLING STATIONS

at Lake Tahoe

Sta. 36 Stateline Beach
Sta. 35 Lakeside Marina
Sta. 34 Tahoe Meadows Estates
Sta. 33 South Tahoe Marina
Sta. 32 Mouth of Bijou Cr.
Sta. 31 Connolly's Intake
Sta. 30 Connolly's Pier
Sta. 29 Surf and Sand Beach
Sta. 28 El Dorado Co. Campground Beach
Sta. 27 Globins Pier
Sta. 26 West Pt. Al Tahoe
Sta. 25 Upper Truckee R. -- 600 yds. Offshore
Sta. 24 Mouth of Upper Truckee R.
Sta. 23 Tahoe Keys - Mouth of Marina
Sta. 22 Pope Beach @ Piling "H"
Sta. 21 Pope Beach @ Jameson Pier
Sta. 20 Camp Richardson Edwards Pier
Sta. 19 Baldwin Beach @ Piling "D"
Sta. 18 Emerald Bay off Vikingsholm Beach
Sta. 17 Bliss State Park Beach
Sta. 16 Rubicon Bay -- Paradise Flat
Sta. 15 Rubicon Bay -- South Beach
Sta. 14 Rubicon Bay -- Launching Ramp
Sta. 13½ Rubicon Point -- 2 miles N.E.
Zephyr Cove
Marla Bay
Stateline
Bijou Park
Bijou
Al Tahoe
Truckee
DOUGLAS CO
EL DORADO
L A K E T A H O E
MAXIMUM ELEVATION 622
Pope Beach
Richardson
Baldwin Beach
Eagle Point
Emerald Bay
Fannette I
Vikingsholm
Rubicon Point
D L BLISS STATE PARK
Rubicon
Bay

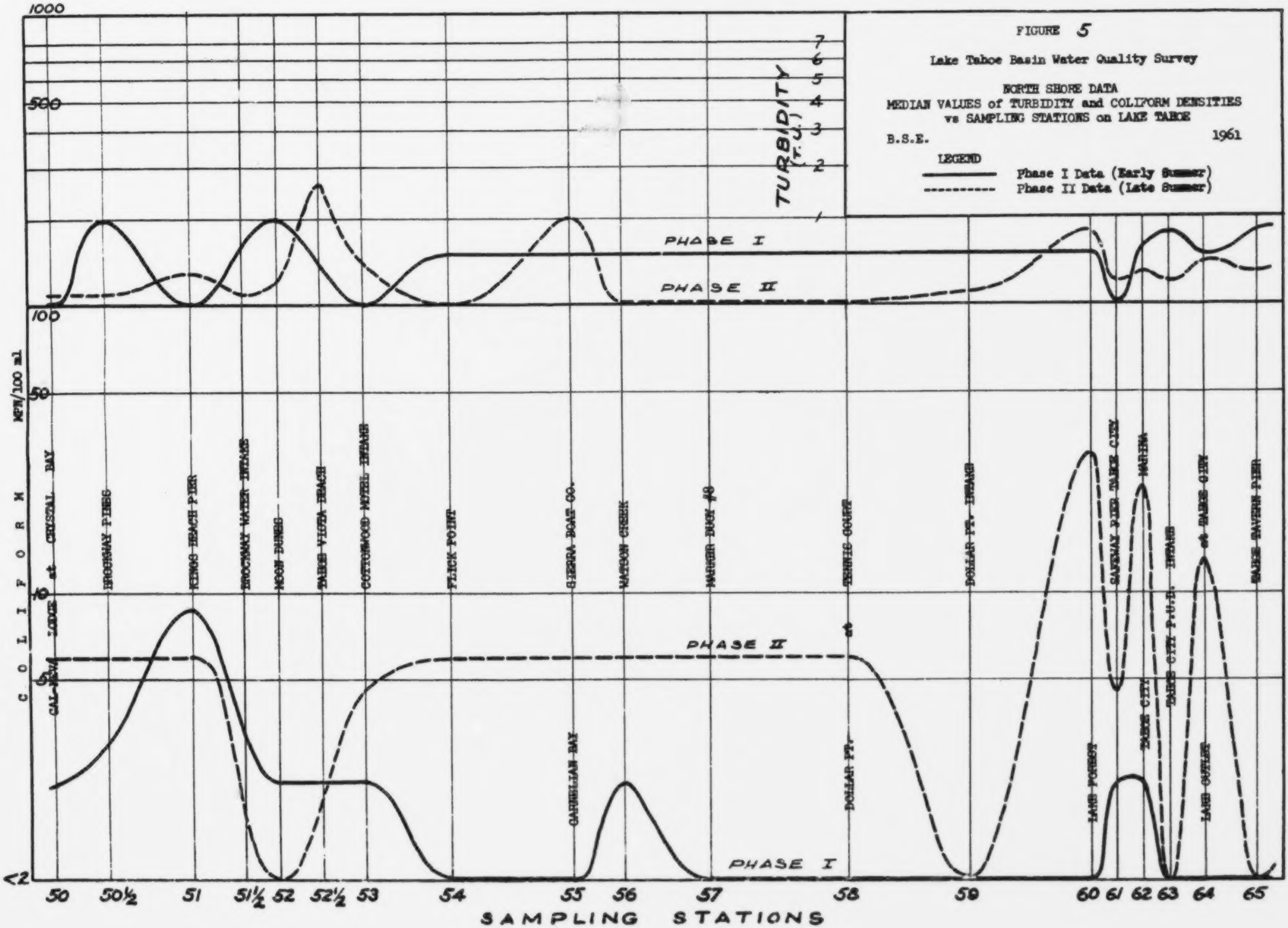


FIGURE 5

Lake Tahoe Basin Water Quality Survey

NORTH SHORE DATA
MEDIAN VALUES of TURBIDITY and COLIFORM DENSITIES
vs SAMPLING STATIONS on LAKE TAHOE

B.S.E.
1961

LEGEND
Phase I Data (Early Summer)
Phase II Data (Late Summer)

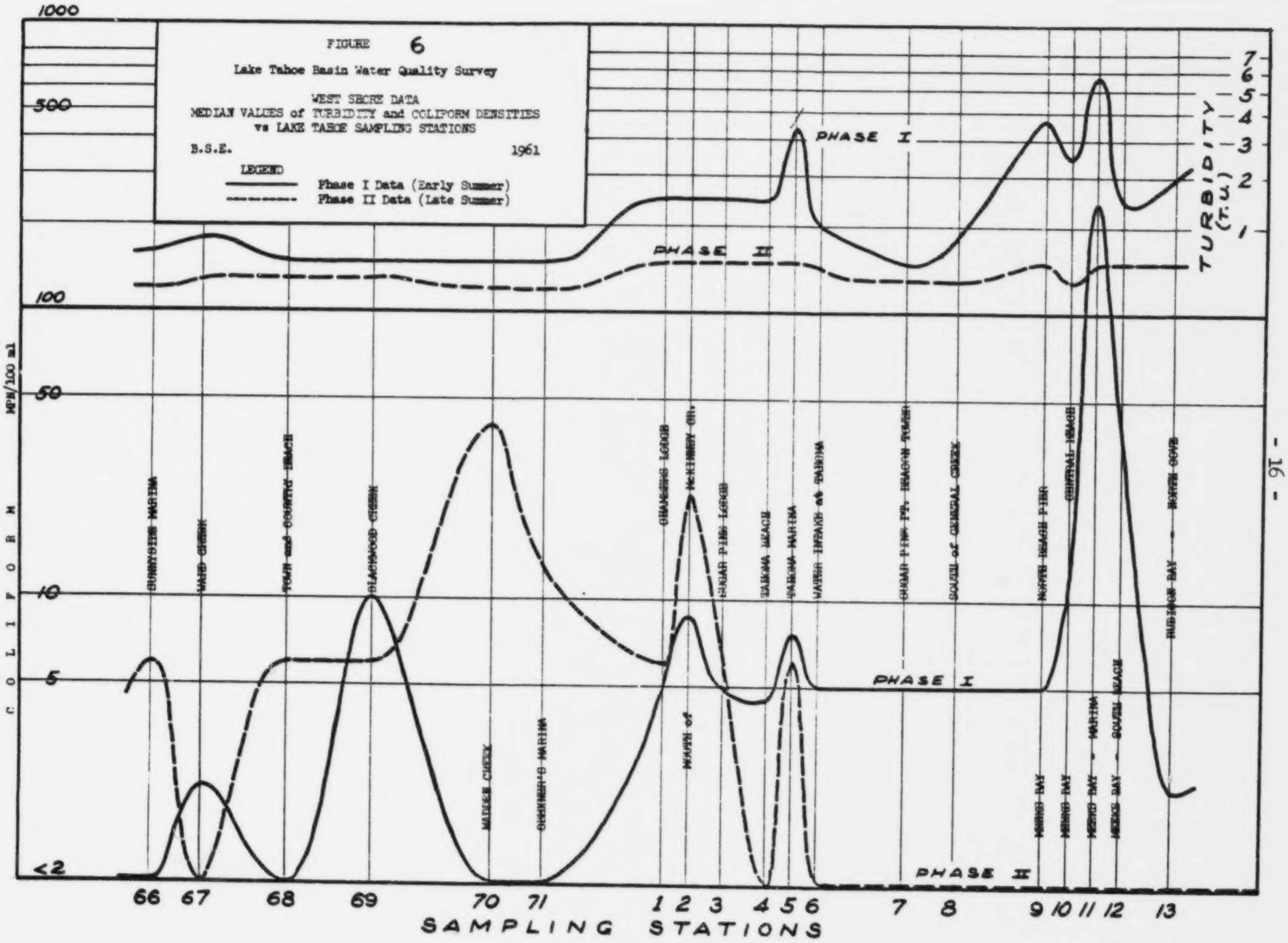


FIGURE 6

Lake Tahoe Basin Water Quality Survey

WEST SHORE DATA
MEDIAN VALUES of TURBIDITY and COLIFORM DENSITIES
vs LAKE TAHOE SAMPLING STATIONS

B.S.E. 1961

LEGEND
Phase I Data (Early Summer)
Phase II Data (Late Summer)

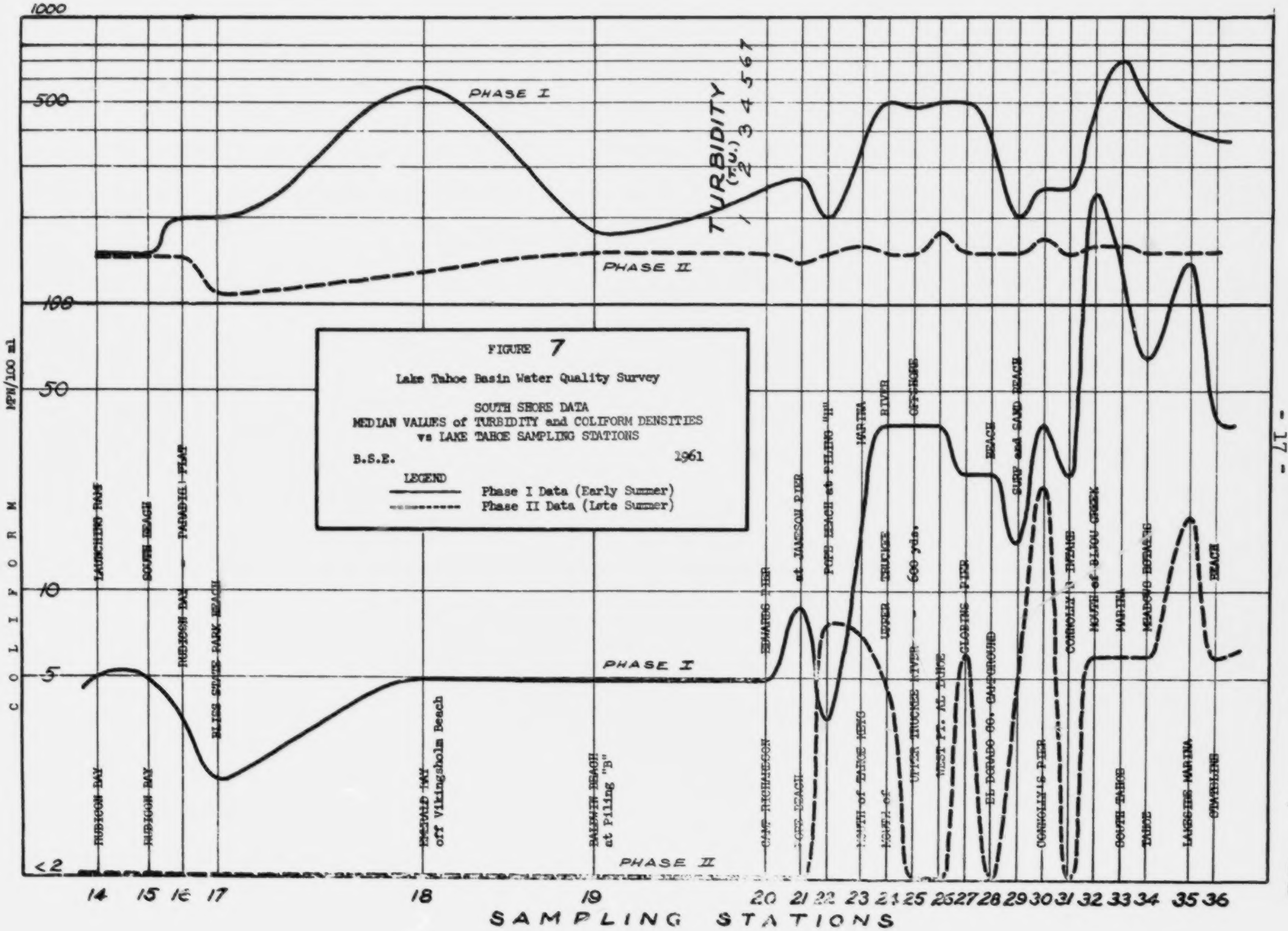


FIGURE 7

Lake Tahoe Basin Water Quality Survey

SOUTH SHORE DATA
MEDIAN VALUES of TURBIDITY and COLIFORM DENSITIES
vs LAKE TAHOE SAMPLING STATIONS

B.S.E. 1961

LEGEND
——— Phase I Data (Early Summer)
- - - - - Phase II Data (Late Summer)

Lake Tahoe Basin Water Quality Survey, 1961

## TABLE I

### MAXIMUM PLANKTON DENSITY
### AT
### LAKE TAHOE SAMPLING STATIONS

(Grouped Into Density Ranges)

| <100 org/ml | 100 - 200 org/ml | 200 - 300 org/ml |
|---|---|---|
| Chamber's Lodge | Blackwood Creek at Hwy 89 | Fallen Leaf Lake (Boat dock) |
| Fallen Leaf Lake Mutual Water Co. Intake | Cal - Neva Lodge | McKinney Creek (Mouth) |
| Lake Tahoe Outlet | Carnelian Bay | Safeway Pier |
| Obexner's Marina | Cottonwood Motel Intake | Spring Creek at Hwy 89 |
| Rubicon Point - 2 miles N.E. (Background) | Madden Creek (Mouth) | Taylor Creek at Hwy 89 |
| Tahoe City - Intake | Meek's Resort (Pier) | Ward Creek (Mouth) |
| Town & Country Lodge (Beach) | Meek's Resort (Beach) | |
| Watson Creek (Mouth) | Tallac Creek at Hwy 89 | |

Table I Continued

| 300 - 500 org/ml | 500 - 600 org/ml | 700 - 800 org/ml . |
|---|---|---|
| (None in this range) | Connolly's Resort (Intake)<br>Pope Beach (Offshore) | Trout Creek (Above Al Tahoe) |

| 800 - 900 org/ml | 900 - 1000 org/ml | 1000 - 2000 org/ml |
|---|---|---|
| Upper Truckee River Near Meyers | Bijou Center Creek (Golz Creek)<br>Emerald Bay (Vikingsholm) | Stateline Marina<br>Tahoe Tavern (Pier) |

| 2000 - 3000 org/ml | 4000 - 5000 org/ml | 9000 - 10,000 org/ml |
|---|---|---|
| Hartoonian's Pier<br>Upper Truckee River (Hwy 50) | Meek's Resort (Marina)<br>Stateline Beach (Offshore)<br>Tahoe Keys Marina (In lagoon) | South Tahoe Marina |

## TABLE II

### RESULTS OF ORGANIC ANALYSES OF SAMPLES COLLECTED FROM LAKE TAHOE

| SAMPLING LOCATION | | Tahoe Cedars Water Co. Phase I | Tahoe Cedars Water Co. Phase II | Tahoe City P.U.D. Phase I | Brockway Water Co. Phase II | Connolly's Resort Phase II |
|---|---|---|---|---|---|---|
| Time Operated | | 6-30<br>7-9 | 8-30<br>9-9 | 7-2<br>7-9 | 8-30<br>9-9 | 9-2<br>9-11 |
| Gallons through Filter | | 8825 | 3315 | 5500 | 8767 | 10,732 |
| Chloroform | (ppb) | 53 | 17 | 24 | 15 | 24 |
| Chloroform % Total Extract | | 33.7 | 16.8 | 25.4 | 20.3 | 35.6 |
| Alcohol | (ppb) | 104 | 86 | 72 | 59 | 43 |
| Alcohol % Total Extract | | 66.3 | 83.2 | 74.6 | 79.7 | 64.4 |
| Total Extract | (ppb) | 157 | 103 | 96 | 74 | 67 |
| ABS | (ppb) | <1 | - | <1 | - | |
| Chloroform Extract | (percent) | | | | | |
| Ether Insol. | " | 7.9 | 12.2 | 8.1 | 11.5 | 2.1 |
| Water Sol. | " | 30.5 | 33.0 | 31.0 | 26.4 | 15.5 |
| Amines | " | 1.1 | 1.8 | 1.7 | 1.2 | 1.3 |
| Strong Acids | " | 10.6 | 4.1 | 6.0 | 5.4 | 8.1 |
| Weak Acids | " | 6.8 | 4.5 | 7.0 | 6.8 | 18.5 |
| Neutrals | " | 19.0 | 23.5 | 32.7 | 29.4 | 37.6 |
| Total | " | 75.9 | 79.1 | 86.5 | 80.7 | 83.1 |
| Loss | " | 24.1 | 20.9 | 13.5 | 19.3 | 16.9 |
| Neutral Fraction | (percent) | | | | | |
| Aliphatics | " | 8.4 | 19.6 | 13.5 | 8.8 | 7.8 |
| Aromatics | " | 3.2 | 5.9 | 4.5 | 4.4 | 5.8 |
| Oxygenates | " | 75.8 | 74.5 | 70.5 | 89.0 | 81.2 |
| Total | " | 87.4 | 100.0 | 88.5 | 102.2 | 94.8 |
| Loss | " | 12.6 | - | 11.5 | - | 5.2 |

## 1. Discussion of Results

Figures 5, 6, and 7 were prepared by plotting median values from the bacteriological and turbidity data assembled for each sampling station. The data obtained from the Phase II portion of the study are shown superimposed on the Phase I results. In this way, comparisons of Phase I and Phase II results can readily be made. The names of specific sampling stations are shown capitalized for easy recognition.

Discussions of these results are made in progression from CAL-NEVA LODGE (Station 50) on the north shore of Lake Tahoe to STATELINE BEACH (Station 36) at the south shore. The sampling stations do not progress in numerical order because the south half of the lake was sampled first, during each study phase. The results of turbidity analyses are discussed here in conjunction with bacteriological results because much evidence points to relationships between these factors. Later in the report, some specific studies and findings are presented to further explore these relationships.

a. Coliform and Turbidity. Coliform densities from CAL-NEVA LODGE to KINGS BEACH remained about the same (6 MPN/100 ml) during Phase II, but an increase was seen during Phase I at KINGS BEACH. This might be attributed to the flows of Griff Creek and others into Agate Bay. This is consistent with slightly higher turbidities found in the bay during Phase I. No discharges or overflows of sewage to the lake were found in this region.

Although median values were less than 10 MPN/100 ml opposite the COTTONWOOD LODGE (Station 53) during both phases, a value of 7000 MPN/100 ml was recorded here during Phase II. This may have been caused by an overflow from a large lily pond at the LODGE. The pond receives drainage from an unsewered area.

Phase I data show very low (<2 MPN/100 ml) results from FLICK POINT (Station 54) to TAHOE CITY (Station 62). The discharge of WATSON CREEK to the lake was probably responsible for a slight increase in coliform density in this locality. In this same area, the Phase II results were somewhat higher (6 MPN/100 ml).

The least affected waters of the entire lake were found at the DOLLAR POINT INTAKE (Station 59). Here the median values of coliform for both study phases were less than 2 MPN/100 ml.

The Phase II median densities rose perceptibly at the stations near TAHOE CITY (Station 62) and the LAKE OUTLET (Station 64). These ranged from 5 to 20 MPN/100 ml. The Phase I samples were in a consistent range, from less than 2.2 to 2.0 MPN/100 ml in this area.

The Phase I median values remained low (<2 to 2.2 MPN/100 ml) throughout the northwest shores to BLACKWOOD CREEK, where the values increased to 10 MPN/100 ml. The Phase II median results rose consistently opposite the resort beaches and marinas in this region (6 to 20 MPN/100 ml).

Phase II results opposite MADDEN CREEK (Station 70) were somewhat higher (40 MPN/100 ml). The creek had only a trickle of flow. The median value of samples collected at this station early in the summer, when there was considerable flow, was less than 2 MPN/100 ml. Being contrary to results usually found, this is difficult to explain.

Resort activities at CHAMBER'S RESORT, SUGAR PINE LODGE, and the stream discharge at McKINNEY CREEK might have been responsible for coliform increases in this region during both phases of study. Values here rose to 10 to 20 MPN/100 ml.

Median values for the three sampling stations in the Tahoma area were greater during the early summer phase (6 to 8 MPN/100 ml), and maximum values opposite TAHOMA BEACH were greater than 240 MPN/100 ml. The trend was the same southward, toward MEEKS RESORT. Phase II medians here were less than 4.5 MPN/100 ml.

Noticeable changes can be seen from the graph at stations along MEEKS BAY during the early summer phase. The median for coliform opposite MEEKS RESORT MARINA rose to 240 MPN/100 ml. Medians of less than 4.5 MPN/100 ml were found here during Phase II. Possibly these results were influenced by the early summer flow of MEEKS CREEK, which discharges to the lake via the small craft marina. Later in the summer, Meeks Creek had little or no flow.

The median values obtained during Phase II continued at less than 4.5 MPN/100 ml at stations south from Meeks Bay, past Rubicon Bay, Emerald Bay, and Camp Richardson. Phase I median values for the same regions were consistent at less than 10 MPN/100 ml.

It is noteworthy to point out that turbidity values were consistently low (0.0 to 1.5) for both phases of study from CAL-NEVA LODGE (Station 50) around the west shore of the lake, past the mouth of the TAHOE KEYS MARINA on the south shore. Turbidity values along the western shores rose only at stations opposite marinas and heavily used resort beaches. At these places, turbidities ranged from 1.5 to 5.7 turbidity units (T.U.).

It is important to note that abrupt changes in both turbidity and coliform densities occur along the extreme south shores of Lake Tahoe, beginning at the mouth of the TAHOE KEYS MARINA and extending eastward to Stateline. The pattern of coliform medians plotted for the fifteen stations along the south shore of Lake Tahoe varies considerably when the results of the two phases are compared. Refer to Figure 7.

During the early summer phase, coliform median densities rose above 10 MPN/100 ml at the mouth of TAHOE KEYS MARINA (Station 23), and then rose to 40 MPN/100 ml opposite the mouth of the UPPER TRUCKEE

RIVER (Station 24). Maximum single coliform values in this area were consistently greater than 240 MPN/100 ml. In this same locality, the median values for turbidity samples rose to about 4.0 T.U., while maximum turbidity values were as high as 7.0 T.U. at a point 600 yards offshore from the mouth of the river. A turbidity value of 9.5 T.U. was recorded a mile east of the mouth of the Upper Truckee River, at GLOBIN'S PIER (Station 27).

Flows from the Upper Truckee River were appreciable during the first phase of sampling, and its discharge to the lake created a fan of turbidity which was quite pronounced to the eye, especially against the background of typically blue Lake Tahoe waters. In the daily log of observations it was noted that the turbid fan moved consistently to the east, or in a counterclockwise movement. A profile of turbidity plotted against the south shore stations in the Phase I period assumes a shape very similar to the profile plot of coliform density.

Median coliform concentrations rose to values greater than 100 MPN/100 ml at the MOUTH OF BIJOU CREEK (Station 32), the SOUTH TAHOE MARINA (Station 33), and the STATELINE MARINA (Station 35), all during the first phase. At eight of the south shore stations, maximum values were greater than 240 MPN/100 ml. Some single values reached 7000 MPN/100 ml.

An analysis of both the coliform and turbidity profiles, along with knowledge by direct observation, suggests that the discharge of the UPPER TRUCKEE RIVER into the waters of Lake Tahoe influences a comparable rise in both measurements during the early summer study phase. The effect of this discharge diminished several miles to the east in the neighborhood of Bijou. The discharge of BIJOU CREEK into Lake Tahoe also has a marked effect on water quality in this area. The waters were colored to a yellowish appearance.

The pattern of both coliform and turbidity analyses plotted along the Tahoe south shore showed a great improvement in water quality during the Phase II (late summer) sampling period. The flows of both the Upper Truckee River and Bijou Creek had diminished to the point of negligible discharge to Lake Tahoe.

While the median turbidity results were consistently low along the south shore (0.5 to 1.0 T.U.), abrupt increases in coliform concentrations usually occurred opposite heavily populated beaches and active marinas.

For further analysis of the influence of the Upper Truckee River flows on the water quality of Lake Tahoe in the south shore region, the reader's attention is invited to the UPPER TRUCKEE RIVER Sub-Study in report section II.

b. Water Temperatures. At the time samples were collected, water temperatures were usually recorded, and the data are presented in the Appendix.

Meteorological data were not collected for presentation in this report or for comparison with observed water temperatures. It was noted, however, that the surface water temperatures of Lake Tahoe responded quickly to ambient air temperatures. For example, the survey crew noted that July 4, 1961 was an unusually chilly day. On the following day, water temperatures along the north lake shores had dropped as much as 6 to 9 degrees Fahrenheit. Air temperatures rose again on July 7th and water temperature rose from 7 to 11 degrees Fahrenheit on the following day.

As would be expected, the warmest waters were found in protected waters of shallow beach areas. Here, during warm days, temperatures were found to be in the high 60's or low 70's.

c. Nitrogen Compounds. Of the 97 samples collected for nitrate-nitrogen (the most highly oxidized state of nitrogen compounds originating in sewage), all but one sample had concentrations below 0.5 mg/l (the sensitivity of the laboratory procedure used). The one exception was the sample collected at Station 57 at MARKER BUOY 8, in which 1.0 mg/l of nitrate-nitrogen was found. Nitrate-nitrogen was below levels of detectability in the subsequent samples collected here.

A few samples were collected for nitrite-nitrogen determinations as a check to determine if nitrogen compounds might be present in an intermediate state of oxidation. Six of nine lake water samples had concentrations less than the level of detection (.001 mg/l). The other three samples had only .001 to .0015 mg/l of nitrite-nitrogen.

From the data collected, there is no evidence that sewage was reaching the waters in any area of Lake Tahoe in sufficient quantities to result in readily measurable increases in nitrate-nitrogen concentrations.

d. Phosphates. Nearly 100 samples were collected from Lake Tahoe for phosphate determinations. All but two samples had concentrations within a "normal" range comparable to the 0.03 to 0.38 mg/l for phosphate found at the "Background" station (Station 13-1/2). The samples having higher than "normal" concentrations both were found at Station 69, which is just offshore from the mouth of Blackwood Creek, on the west shore of Lake Tahoe. These samples showed analyses of 1.82 and 0.44 mg/l for phosphate. It was not established that these concentrations were contributed solely by Blackwood Creek, since only one sample for phosphate analysis was collected from this stream. This sample contained only 0.02 mg/l of phosphate.

e. Chlorides. Since the natural chloride content of Lake Tahoe water is low, chloride analyses were included for samples collected during the second phase of the survey to serve as an additional index of sewage pollution. Chloride determinations were made on several hundred samples collected for this purpose, and no areas were found which had chlorides in a significantly high level. Chlorides were usually found to range between 1.0 and 2.5 mg/l. The highest chloride value was 4.0 mg/l.

This was found at the mouth of Tahoe Keys (Station 23). Eight other samples taken at this sampling station ranged from 2.0 to 2.5 mg/l. The chloride concentration at the "Background" station (Station 13-1/2) was 2.0 mg/l. There is no evidence that sewage was reaching Lake Tahoe waters in sufficient quantities to show measurable increases in chloride concentrations.

f. Synthetic Detergent (ABS). Analyses of lake water samples were made for the presence of alkyl-benzene-sulphonate (ABS). This chemical is the surface-active agent widely used in the compounding of synthetic detergents such as bath soaps, shampoos, laundry and dishwashing products. Since ABS resists biological breakdown, its presence in waters may be an index to sewage pollution.

Traces of ABS were found in 16 of the 454 offshore lake samples collected. The "positive" ABS samples (0.1 to 0.3 mg/l) were found at 15 stations, with one station (Station 27 - Globin's Pier) having two "positive" samples. Attempts were made to determine relationships with these "positive" ABS findings with other parameters of sewage pollution, and none existed. It was noted that 10 of the 16 "positive" ABS findings were made when samples were collected from piers or marinas during periods when the survey boat was inoperative. The samples collected in this manner were closer to marina entrances or launching facilities than those collected from the survey boat.

A mixture of gasoline and oil used in the Department's outboard motor was analyzed for ABS, and it was found that a fuel concentration of 10 mg/l would give a laboratory result of 0.1 mg/l ABS. Serious interference with the test for ABS was noted at 100 mg/l mixture of the fuel and water. Research chemists for the company which made the oil advised that the oil was of the non-detergent type, and that the interference with the colorimetric test for ABS might have come from the gasoline.

Perhaps the irregular ABS results might have resulted from oil and fuel films on water surfaces since sample bottles were filled from the lake surfaces by hand. Also, synthetic detergents containing ABS are used to wash down boats, and the "positive" findings might have originated from this source. The possibility that the detergent residuals found originated from bathers seems unlikely, since ABS was found in only one of many samples taken from beach areas. This sampling point was also near a marina entrance.

g. Plankton. Surface samples were collected for plankton analyses at selected sampling stations located at or near the mouths of tributary streams and at popular bathing areas. At some stations, only one sample was collected, and at others, as many as eight. Samples were preserved with formalin for subsequent analysis at the Berkeley laboratory.

A summary of the quantitative data expressed in total organisms per milliliter and the dominant organisms found is presented in the Appendix, where all data are summarized for individual stations. Also presented in the Appendix is a general listing of the types of organisms found.

Individual laboratory report forms which classify into major groups the types of organisms found are not included in the report. This information is available for office review.

Personnel collecting samples during the survey were alert to note areas where aquatic weed growths of dense algaes were occurring. Aquatic weeds (pondweed) were noted along the south shore of Lake Tahoe, and they were relatively dense near El Dorado County Beach. Weeds were also noted near the mouth of Eagle Falls Creek (Emerald Bay) and offshore from Tahoe Tavern and the Tahoe City State Campground. Early in July, a yellow scum (later identified as pine pollen) was very noticeable in the coves of Emerald Bay, Fallen Leaf Lake, and at the mouth of the Upper Truckee River. Pollen conditions of this magnitude were not observed during the latter period of the survey.

No areas were found which had sufficient growths of plankton to be noticeable to observers along the shoreline or from the sampling boat. Near Tahoe Pines, however, a crewman noted "red insects" swimming in a gallon jug of water collected for plankton analysis. The organisms were broadly identified as copepods.

It will be noted in Table I that the most dense growths of plankton (ranges from 1000 to 5000 organisms per ml) were found in the marinas and the shallow areas along the south shore of Lake Tahoe. Lesser densities (500 to 1000 organisms per ml) were found along the southwest shore, Emerald Bay, and the west shore, except near the pier at Tahoe Tavern, where 1600 organisms per ml were found in one sample. The north end of Lake Tahoe had relatively low densities of plankton, except for one sample which was collected offshore from Brockway Beach. It is also noted that the streams tributary to the south end of Lake Tahoe were relatively high in plankton.

A few samples were collected for nitrate and phosphate analyses to determine to what extent these growth-essential elements were present. In nearly all but a few samples, the concentrations of phosphate and nitrate were low or were below the sensitivity of the tests used. From these data it is not possible to determine relationships between nutrient and plankton concentrations.

If the levels of plankton are compared with the measurements of water temperatures, it will be noted that the highest plankton densities were found in areas of warmer waters. The plankton densities, as well as the water temperatures, were generally lower during the second phase of sampling.

h. Organic Analysis (Carbon Adsorption). Five samples of lake water were collected from major domestic water supply intakes at Lake

Tahoe by the carbon adsorption method. The concentrations of organic fractions were well below the U.S. Public Health Service's recommended limit of 200 parts per billion (ppb) for carbon chloroform extract in the 1962 revision of the Drinking Water Standards.

The results ranged from 15 to 53 ppb for chloroform extract, and the highest value was obtained from the sample collected at the lake intake operated by the Tahoe Cedars Water Company at Tahoma. Organic analyses data are shown in Table II.

## B. FALLEN LEAF LAKE

The water quality conditions in Fallen Leaf Lake were studied both by boat and by shoreline land sampling on June 20 and 21 in the first phase, and on August 26 and 27 during the second phase. The bacteriological and chemical sampling techniques used were the same as those employed in the Lake Tahoe investigations. Studies were also made along Glen Alpine Creek, which is a main tributary to the lake at the northwest shore. Figure 8 is a sketch showing the Fallen Leaf Lake Sampling Stations. Data are presented in the Appendix.

A carbon filter was set up at the lake intake pumphouse which is operated by the Fallen Leaf Lake Mutual Water Company.

General information concerning sanitary conditions was obtained from the local health department, from a water system manager and others. It was reported that numerous cabins along the south shore of Fallen Leaf Lake have had histories of failing sewage disposal systems and, at times, sewage has drained into the lake. The shoreline is steep and rocky in this region and many of the cabins are built quite close to the water's edge. In such terrain the effective disposal of septic tank effluent to leaching beds is very difficult to accomplish. Some have installed lakefront sumps, from which sewage is pumped uphill to more suitable areas for percolation. Special interest was taken to locate any systems which might be failing in this area.

A contractor explained that the Stanford High Sierra Camp at Fallen Leaf Lake is situated in a rocky area with very little loose soil. He developed the sewage disposal system,employing septic tanks and percolation beds. In places he resorted to powder blasting to open rock fissures, to enable some degree of percolation. Special attention was devoted to sampling in this area.

Table III, which follows, lists the results of the organic analyses (carbon adsorption) which were performed on these waters. The samples were collected from the public water supply intake of the Fallen Leaf Lake Mutual Water Company.

For the DATA SHEETS of the LAKE WATER SAMPLING PROGRAM

at FALLEN LEAF LAKE see the APPENDIX of this report

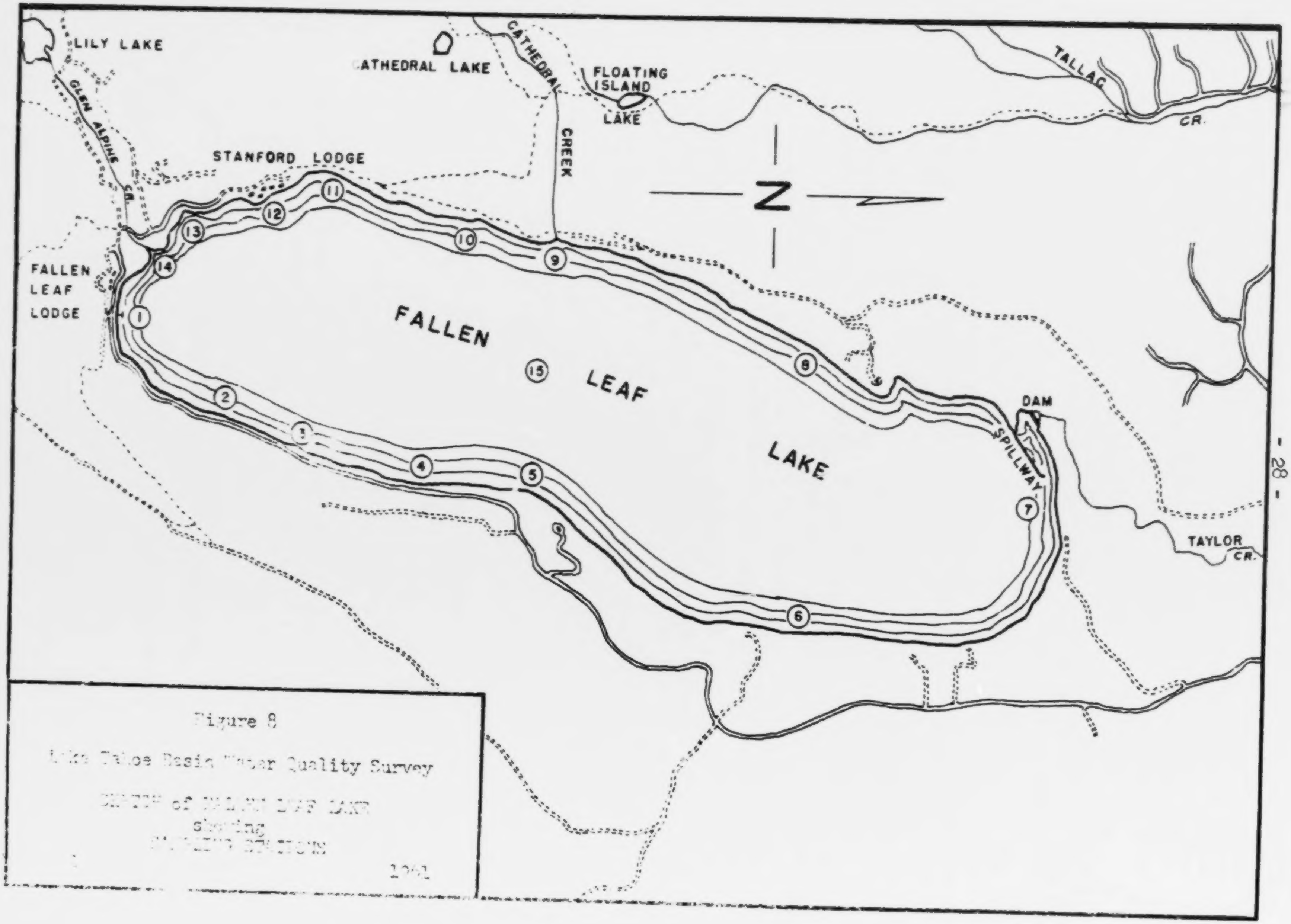

LILY LAKE
GLEN ALPINE CR.
CATHEDRAL LAKE
CATHEDRAL CREEK
FLOATING ISLAND LAKE
TALLAC CR.
STANFORD LODGE
FALLEN LEAF LODGE
N
FALLEN LEAF LAKE
DAM
SPILLWAY
TAYLOR CR.
1
2
3
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Figure 8

Lake Tahoe Basin Water Quality Survey

SKETCH of FALLEN LEAF LAKE
Showing
SAMPLING STATIONS

1961

Lake Tahoe Basin Water Quality Survey, 1961

## TABLE III

### RESULTS OF ORGANIC ANALYSES OF SAMPLES COLLECTED FROM FALLEN LEAF LAKE

| SAMPLING LOCATION | | Fallen Leaf Lake Mutual Water Company | |
|---|---|---|---|
| | | Phase I | Phase II |
| Time Operated | | 6-23<br>7-2 | 9-2<br>9-11 |
| Gallons through Filter | | 7000 | 11,820 |
| Chloroform | (ppb) | 53 | 58 |
| Chloroform % Total Extract | | 33.7 | 41.2 |
| Alcohol | (ppb) | 104 | 83 |
| Alcohol % Total Extract | | 66.3 | 58.8 |
| Total Extract | (ppb) | 157 | 141 |
| ABS | (ppb) | <1 | <1 |
| Chloroform Extract | (percent) | | |
| Ether Insol. | " | 7.9 | 13.0 |
| Water Sol. | " | 30.5 | 28.3 |
| Amines | " | 1.1 | 1.2 |
| Strong Acids | " | 10.6 | 9.8 |
| Weak Acids | " | 6.8 | 6.2 |
| Neutrals | " | 19.0 | 16.7 |
| Total | " | 75.9 | 75.2 |
| Loss | " | 24.1 | 24.8 |
| Neutral Fraction | (percent) | | |
| Aliphatics | " | 9.6 | 9.9 |
| Aromatics | " | 1.2 | 2.5 |
| Oxygenates | " | 80.8 | 91.4 |
| Total | " | 91.6 | 103.8 |
| Loss | " | 8.4 | - |

### 1. Discussion of Results

Coliform bacteria analyses, synthetic detergent (ABS), and chloride determinations were performed on both surface and bottom waters. A few samples were examined for plankton, turbidity, nitrite, nitrate and phosphate.

a. Coliform Organisms. A total of 45 surface and 53 depth samples was analyzed for coliform bacteria. The surface samples exhibited a wider range of values than the depth samples and were generally higher in number. The median MPN of surface samples was 23/100 ml.

Along the northwest shores of the lake, consistently higher levels of coliform bacteria were noted. One sample had an MPN greater than 24,000/100 ml. The Stanford Sierra Lodge and many cabins are located here. Station 14 is at the mouth of Glen Alpine Creek, an important tributary to the lake. At Station 13 there is a small swimming area. The combination of the greater land development, resort recreational activity and the influence of Glen Alpine Creek may have caused the higher coliform concentrations in this area.

b. Synthetic Detergent (ABS) and Chloride. Results of all 47 samples analyzed for ABS were found to be less than 0.1 mg/l, the smallest amount considered to be of significance by the test methods used in the study. The chloride concentration in all 36 samples collected along the periphery of the lake was 1.0 mg/l.

c. Plankton. A heavy film of yellow tree pollen was observed along the southern shoreline of Fallen Leaf Lake during the first phase of study. Aquatic weed growths were not seen, and plankton densities were low. Samples collected near the boat dock and at the intake of the Fallen Leaf Lake Mutual Water Company had 230 and 74 organisms per ml, respectively. The predominant organism was Glenodinium, a pigmented flagellate.

d. Organic Analysis (Carbon Adsorption). A sample for organic analysis was collected during each study phase at the lake intake pump house operated by the Fallen Leaf Lake Mutual Water Company. The concentrations of all organic extracts and fractions were quite low. Both samples had concentrations of chloroform extract well below the U.S. Public Health Service's recommended limit of 200 parts per billion (ppb). For these samples, the chloroform extract was 53 and 58 ppb for Phases I and II, respectively.

## C. DONNER LAKE

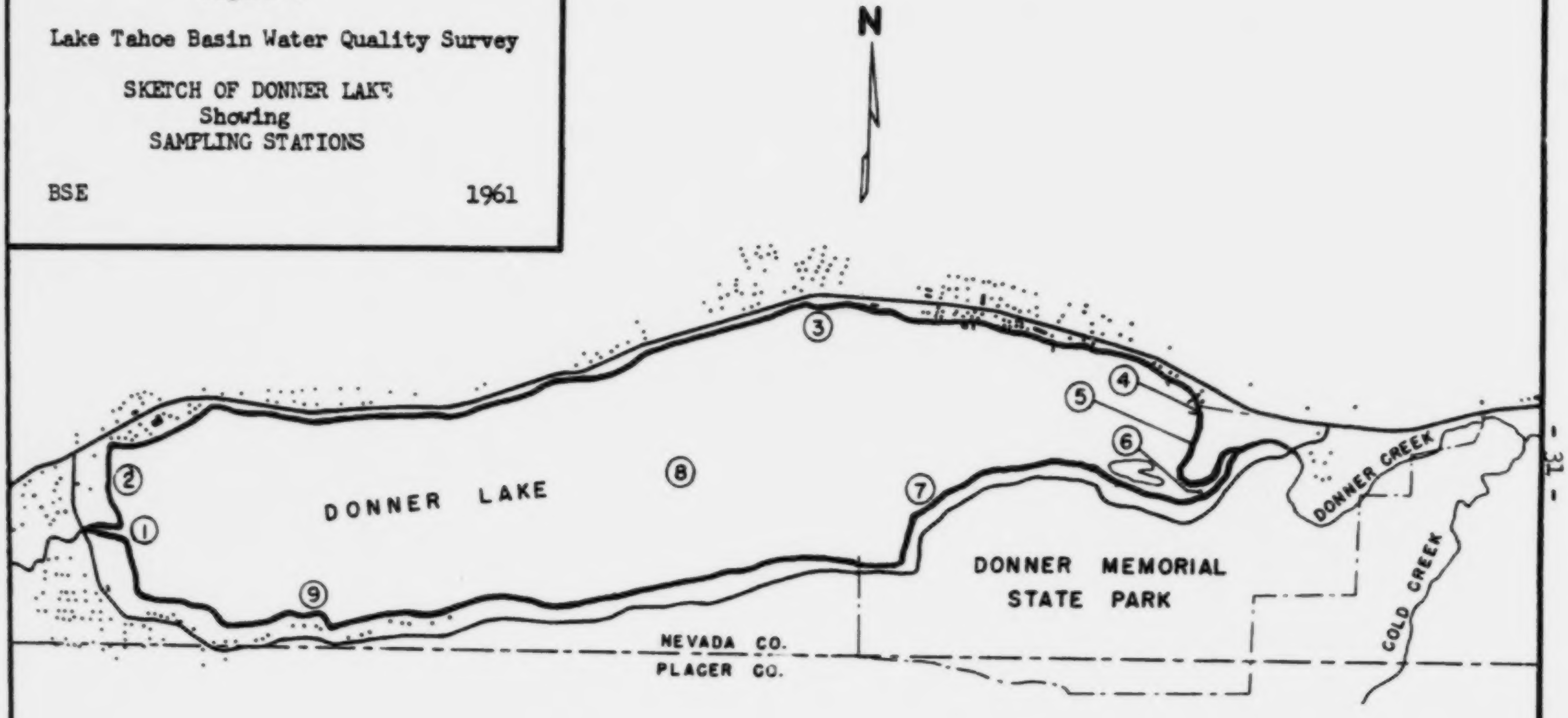
The water quality conditions in Donner Lake were also studied by boat and by shoreline land sampling on July 5 and 7 during the first study phase. Unexpected manpower difficulties prevented a repeat study during the late summer phase in August and September. The bacteriological and chemical sampling techniques used were the same as those in the Lake Tahoe

Figure 9

Lake Tahoe Basin Water Quality Survey

SKETCH OF DONNER LAKE
Showing
SAMPLING STATIONS

BSE 1961


N
DONNER LAKE
DONNER MEMORIAL
STATE PARK
DONNER CREEK
COLD CREEK
NEVADA CO.
PLACER CO.
①
②
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④
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⑦
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⑨

## TABLE IV

## RESULTS OF ANALYSES FROM SAMPLES COLLECTED AT DONNER LAKE

| STATION & DESCRIPTION | DATE | TIME | COLIFORM (MPN/100 ml) | ABS (mg/1) | TURBIDITY (T.U.) | NITRATE (mg/1) |
|---|---|---|---|---|---|---|
| (1) Mouth of Donner Creek | 7-7 | - | 38,240 | <0.1 | 1.0 | - |
| (2) West Donner Beach | 7-7 | - | 38, 5, 38 | <0.1 | - | - |
| (3) North Shore 15' offshore | 7-7 | - | 15, 8.8 | <0.1 | 1.0 | <0.5 |
| (4) Donner Park Boat Dock | 7-7 | - | 15, 12 | <0.1 | 1.0 | <0.5 |
| (5) Donner Park Public Beach | 7-7<br>7-5 | 1015<br>- | 5, 8.8<br>38, 240 | <0.1<br><0.1 | 1.5<br>1.5 | <0.5<br><0.5 |
| (6) Donner Lake Outlet | 7-5<br>7-7 | 1125 | 240, 240<br>15 | <0.1 | 1.0 | <0.5 |
| (7) Donner Park Southeast Beach | 7-5<br>7-7 | 1100<br>- | 240, 240<br>15, 38 | -<br><0.1 | -<br><0.5 | -<br><0.5 |
| (8) Center of Lake | 7-5 | - | 240, 240 | <0.1 | 0.5 | - |
| (9) Property Owners Beach | 7-5 | 1005 | 8.8, 8.8 | | | |

investigations. Results of sampling in previous seasons, and Basin survey preliminary results, showed that the Donner Lake waters were of very high quality.

Studies were concentrated along the shoreline at popular beaches and at boating piers and launching ramps. A few samples were collected by boat from the center of the lake for "Background", or comparison study. No organic sample (carbon adsorption) was collected from Donner Lake. The local health department area sanitarian was well acquainted with the sanitation conditions surrounding the lake, and he knew of no sewage disposal failures or overflows to the lake in recent seasons.

The sketch of Donner Lake in Figure 9 shows locations of the selected sampling stations and other details of interest. Table IV, which follows, is a summary of the results obtained from the lake sampling.

### 1. Discussion of Results

a. Coliform Bacteria and Turbidity. The levels of turbidity were quite low in Donner Lake, having ranged from less than 0.5 to 1.5 T.U. Likewise, the coliform analyses were in a low range. A total of 24 coliform samples was collected, and no single sample exceeded 240 MPN/100 ml. Many of the shoreline samples ranged from 5 to 38 MPN/100 ml. It is interesting to note that of two samples collected from the center of the lake for "Background", both showed results of 240 MPN/100 ml. Since only two samples were collected at this station, no explanation can be given of what appears to be a relatively high bacterial density. A total of 8 samples was collected from the public beaches at the Donner Memorial State Park at the eastern shore of the lake. Coliform results here ranged from 5 to 240 MPN/100 ml.

Water conditions throughout the lake appeared to be excellent and there was no evidence that sewage was reaching the waters in sufficient quantity to be detectable by laboratory measurement.

b. Synthetic Detergent (ABS). Of a total of nine samples collected and analyzed for synthetic detergent, all were found to be less than determinable levels (i.e., $<0.1$ mg/l).

c. Nitrate-Nitrogen. All six samples analyzed for nitrate-nitrogen showed results less than determinable levels (i.e., $<0.5$ mg/l).

Samples were not collected for chloride, phosphate, or organic analyses.

## D. BEACH STUDIES

There were instances during the early summer phase of sampling when the survey boat was inoperative, and on these days the survey team collected samples on foot at key sampling stations and from popular beaches and marinas.

Results obtained from these sampling runs showed relatively higher levels of coliform bacteria, turbidity and chloride than those collected further offshore by boat. These results raised certain questions, especially regarding the higher coliform levels found at beaches: Are the coliform bacteria primarily introduced into the waters by bathers? Do the coliform organisms primarily originate from local land drainage or the seepage of sewage? Are most coliform organisms found in the beach areas resuspended from bottom sediments because of water agitation from swimmers and/or wave action?

Two sampling techniques were used to obtain data which might lead to answers to these questions. Seven popular beaches along the south shores of Lake Tahoe were selected for representative beach stations. Meeks Bay was also given additional attention since sampling results from the early summer investigation showed an abrupt rise in coliform bacteria and turbidity in this region. The Meeks Bay sampling results and discussions are shown at the end of this chapter. The special beach study methods described below were not used at Meeks Bay.

### 1. Method A

The special beach stations were sampled both in the early morning hours and in the afternoon at the peak of bathing population. If bacterial concentrations were found to be greater during the afternoon, one might conclude that the bodies of the bathers or the agitation of the waters might be accountable for the reduction in water quality. Very few persons were observed swimming before 11 A.M.

### 2. Method B

Assuming that Method A has shown that coliform and turbidity densities were greater during the afternoon hours, one might consider that the water quality at these beaches may have been degraded primarily by water agitation and resuspension of coliform organisms from bottom sediments. It may follow that, if the stations were sampled early in the morning when there was little water sports activity, the possibility of the waters being affected by wind and wave action or by bathers could be eliminated, essentially. The lake was usually glass-smooth in the morning.

In order to assure consistency in sampling procedure, one person completed the special beach investigations. Samples were collected in waist-deep waters in the early morning hours at Station 3-X (the west beach of the South Tahoe marina). All possible aseptic precautions were taken. At the designated place, samples were collected both from the surface and from roiled bottom sediments. This was done by disturbing the bottom sediments by hand.

In both methods of sampling described above, parallel laboratory tests were made from each sample for routine coliform analysis and for fecal coliform differentiation. The results of these findings are

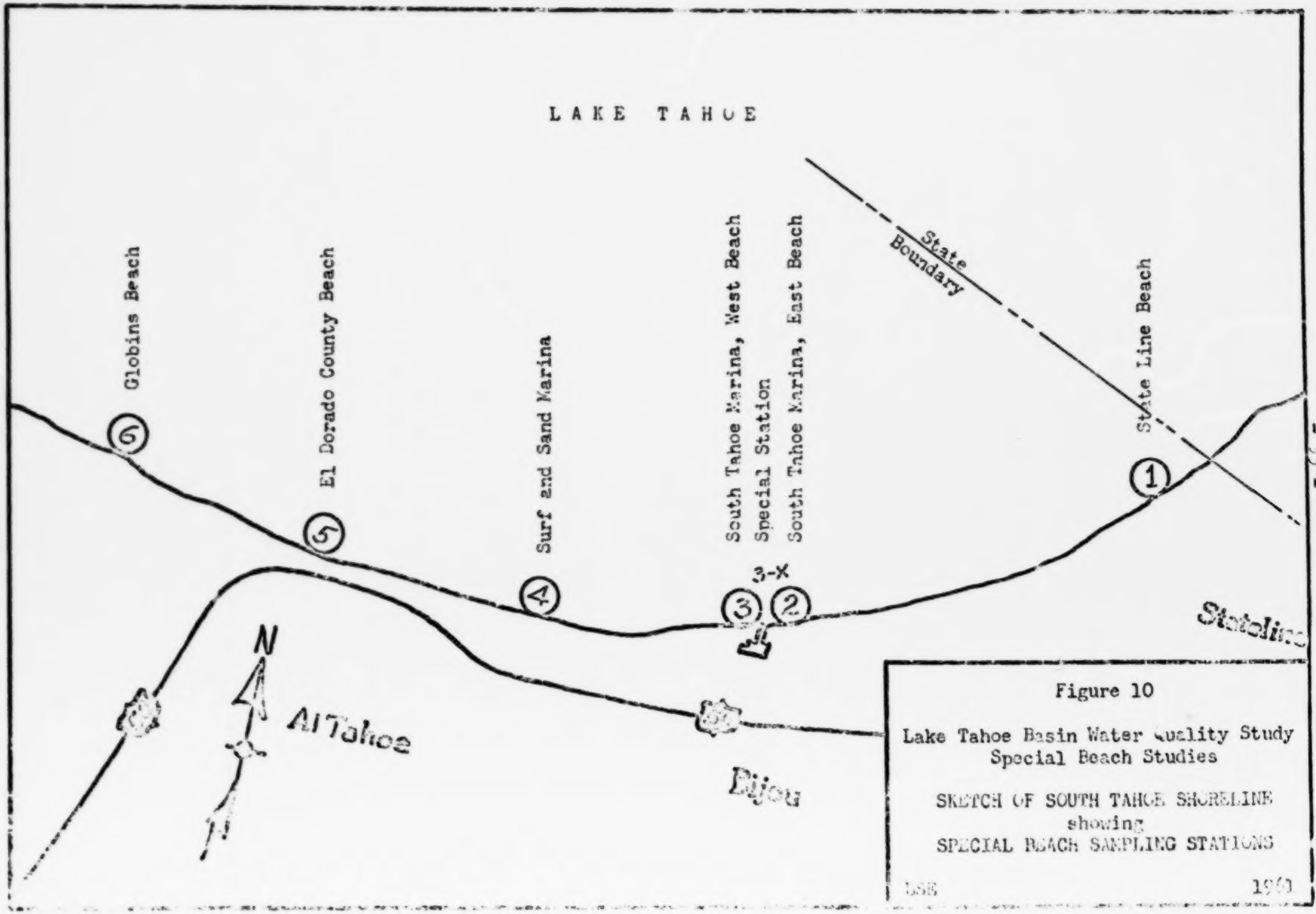

LAKE TAHOE
State Boundary
State Line Beach
South Tahoe Marina, East Beach
Special Station
South Tahoe Marina, West Beach
Surf and Sand Marina
El Dorado County Beach
Globins Beach
1
2
3
3-X
4
5
6
Stateline
Bijou
Al Tahoe
N

Figure 10

Lake Tahoe Basin Water Quality Study
Special Beach Studies

SKETCH OF SOUTH TAHOE SHORELINE
showing
SPECIAL BEACH SAMPLING STATIONS

LSE 1960

## TABLE V

## SPECIAL BEACH STUDIES

## DESCRIPTION OF SAMPLING STATIONS AT POPULAR BEACHES

| BEACH NUMBER | DESCRIPTION OF SAMPLING STATIONS |
|---|---|
| 1. | STATELINE BEACH: Middle of swimming area near concession building, 1.5 to 2.0 feet depth of water, surface sample, 8 to 10 feet from shore. |
| 2. | SOUTH TAHOE MARINA, EAST BEACH: 100 to 150 feet east of boat channel at fence line, east edge of beach, 1 to 2 feet depth of water, surface sample, 8 to 15 feet from shore. |
| 3. | SOUTH TAHOE MARINA, WEST BEACH: 100 to 150 yards west of boat channel, 1 to 2 feet depth of water, surface sample, 8 to 15 feet from shore. |
| 3-X. | SOUTH TAHOE MARINA, WEST BEACH: 150 to 200 yards from shore, 3 sample points, 20 yards apart, surface and roiled-bottom samples. |
| 4. | SURF AND SAND MARINA: 100 to 150 yards west of pier, 1 to 2 feet depth of water, surface sample, 10 to 30 feet from shore. |
| 5. | EL DORADO COUNTY BEACH: At boat launching ramp, 0.75 to 2.0 feet depth of water, surface sample, 25 to 100 feet from shore. |
| 6. | GLOBIN'S BEACH: 100 to 150 yards west of Globin's Pier, 0.75 to 1.0 feet depth of water, surface sample, 75 to 150 feet from shore. |
| 7. | RICHARDSON BEACH: Near parking lot - concession building, 1 to 3 feet depth of water, surface sample, 8 to 10 feet from shore. |

## TABLE VI

## SPECIAL BEACH STUDIES

### RESULTS OF ANALYSES FROM SAMPLES COLLECTED AT SEVEN BEACH STATIONS
### RESULTS OF ANALYSES FROM BEACH STATION 1

### STATELINE BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/l | Turbidity T.U. | Cl mg/l | $NO_3$ mg/l |
| Wednesday 8-23-61 | 0935 | 40 | - | 230<br>230 | -<br>- | <0.1 | 0.5 | 2.5 | - |
| | 1400 | 150-200 | 50 | 62<br>62 | -<br>- | <0.1 | 2.5 | 2.5 | - |
| Thursday 8-24-61 | 1305 | 180-200 | 15 | 62<br>62 | -<br>- | <0.1 | 1.2 | 3.0 | - |
| Friday 8-25-61 | 0810 | 2 | 0 | 23<br>62 | -<br>- | <0.1 | 0.6 | 2.0 | <0.5 |
| | 1250 | 150-200 | 7 | 2300<br>620 | -<br>- | <0.1 | 1.8 | 3.0 | <0.5 |

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

RESULTS OF ANALYSES FROM BEACH STATION 1

STATELINE BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | $C_1$ mg/1 | $NO_3$ mg/1 |
| Monday 8-28-61 | 0820 | 0 | 0 | 4.6<br>6 | -<br>- | <0.1 | 0.5 | 2.5 | - |
| | 1342 | 58 | 4 | 62<br>62 | -<br>- | <0.1 | 1.2 | 2.5 | |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

## RESULTS OF ANALYSES FROM BEACH STATION 2

## SOUTH TAHOE MARINA - EAST BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/l | Turbidity T.U. | Cl mg/l | $NO_3$ mg/l |
| Wednesday 8-23-61 | 1009 | - | - | 620<br>230 | 6<br>23 | <0.1 | 5.0 | 2.5 | - |
| | 1430 | 100 | 15 | 130<br>230 | 6<br>23 | <0.1 | 7.0 | 3.0 | - |
| Thursday 8-24-61 | 1335 | 42 | 8 | 620<br>230 | -<br>- | <0.1 | 5.7 | 3.0 | - |
| Friday 8-25-61 | 0830 | 1 | 0 | 23<br>62 | <4.5<br>6 | <0.1 | 1.8 | 3.0 | - |
| | 1545 | 50 | 4 | 500<br>230 | -<br>- | <0.1 | 5.7 | - | |
| Monday 8-28-61 | 0845 | 3 | 0 | 62<br>13 | -<br>- | <0.1 | 0.6 | 3.0 | - |
| | 1410 | 16 | 6 | 700<br>240 | -<br>- | - | - | 2.5 | - |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

## RESULTS OF ANALYSES FROM BEACH STATION 3

## SOUTH TAHOE MARINA - WEST BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | $C_1$ mg/1 | $NO_3$ mg/1 |
| Wednesday 8-23-61 | 1020 | - | - | 230<br>620 | 6<br>6 | - | - | - | - |
| | 1430 | 250-300 | 30 | 230<br>230 | 13<br>23 | - | - | - | - |
| Thursday 8-24-61 | 1335 | 225-250 | 30-40 | 230<br>230 | -<br>- | - | - | - | - |
| Friday 8-25-61 | 0830 | - | - | 230<br>230 | 23<br><4.5 | - | - | - | - |
| | 1545 | 150-200 | 1-2 | 230<br>230 | -<br>- | - | - | - | - |
| Monday 8-28-61 | 0850 | - | - | <4.5<br>23 | - | - | - | - | - |
| | 1415 | 17 | 4 | 62<br>240 | -<br>- | - | - | - | - |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

### RESULTS OF ANALYSES FROM BEACH STATION 3-X

### SOUTH TAHOE MARINA - WEST BEACH

(150 to 200 yards from shore)

| SAMPLING DATE | SAMPLE SUB-POINTS | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSES (MPN/100 ml) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | COLIFORM | | FECAL COLIFORM | |
| | | | on Beach | in Water | Surface | Roiled Bottom | Surface | Roiled Bottom |
| Thursday 8-24-61 | A | 0815 | 3 | 0 | 23 | 23 | 6 | 23 |
| | B | 0820 | 3 | 0 | 62 | 620 | <4.5 | <4.5 |
| | C | 0825 | 3 | 0 | 620 | 62 | 6 | 23 |
| Wednesday 8-30-61 | A | 0730 | 1 | 0 | <4.5 | 4.5 | - | - |
| | B | 0735 | 1 | 0 | <4.5 | 13 | - | - |
| | C | 0740 | 1 | 0 | <4.5 | <4.5 | - | - |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

### RESULTS OF ANALYSES FROM BEACH STATION 4

### SURF AND SAND MARINA

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | Cl mg/1 | $NO_3$ mg/1 |
| Wednesday 8-23-61 | 1035 | 6 | 2 | 620<br>230 | -<br>- | <0.1 | 2.3 | 1.5 | - |
| | 1450 | 60 | 7 | 620<br>230 | -<br>- | <0.1 | 5.0 | 2.5 | - |
| Thursday 8-24-61 | 1400 | 50 | 8 | 620<br>620 | -<br>- | <0.1 | 3.0 | 3.0 | - |
| Friday 8-25-61 | 0850 | 2 | 4 | 23<br>230 | -<br>- | <0.1 | 1.8 | 2.5 | - |
| | 1530 | 50 | 5 | 500<br>62 | -<br>- | <0.1 | 3.8 | 3.0 | - |
| Monday 8-28-61 | 0910 | 0 | 0 | 6<br>23 | -<br>- | <0.1 | 0.8 | 3.0 | - |
| | 1430 | 0 | 0 | 62<br>23 | -<br>- | <0.1 | 1.5 | 2.5 | - |

**TABLE VI** (continued)

RESULTS OF ANALYSES FROM BEACH STATION 5

EL DORADO COUNTY BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | $C_1$ mg/1 | $NO_3$ mg/1 |
| Wednesday 8-23-61 | 1045 | 150 | 10 | 230<br>620 | -<br>- | <0.1 | 3.0 | 2.0 | - |
| | 1510 | 350-400 | 100 | 620<br>620 | -<br>- | <0.1 | 5.7 | 2.5 | - |
| Thursday 8-24-61 | 1423 | 300-350 | 60-70 | 23<br>230 | -<br>- | <0.1 | 2.3 | 3.0 | - |
| Friday 8-25-61 | 0910 | 15 | 3 | 23<br>620 | -<br>- | <0.7 | 3.0 | - | - |
| | 1515 | 300 | 55 | 50<br>62 | -<br>- | <0.1 | 2.3 | 3.0 | - |
| Monday 8-28-61 | 0930 | 0 | 0 | 23<br>240 | -<br>- | <0.1 | 1.1 | 2.5 | - |
| | 1500 | 0 | 0 | 23<br>4.6 | -<br>- | <0.1 | 1.3 | 2.0 | - |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

## RESULTS OF ANALYSES FROM BEACH STATION 6

## GLOBIN'S BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | Cl mg/1 | $NO_3$ mg/1 |
| Wednesday 8-23-61 | 1100 | 9 | 0 | 620<br>230 | -<br>- | <0.1 | 1.7 | 2.0 | - |
| | 1525 | 31 | 21 | 620<br>2300 | -<br>- | <0.1 | 6.5 | 2.5 | - |
| Thursday 8-24-61 | 1440 | 36 | 11 | 230<br>12 | -<br>- | <0.1 | 3.0 | 2.5 | - |
| Friday 8-25-61 | 0930 | 7 | 3 | 500<br>500 | -<br>- | <0.1 | 1.8 | 3.0 | <0.5 |
| | 1440 | 25 | 2 | 23<br>230 | -<br>- | <0.1 | 2.1 | 3.0 | <0.5 |
| Monday 8-28-61 | 0945 | 0 | 0 | 9.2<br>12 | -<br>- | <0.1 | 1.0 | 3.5 | - |
| | 1507 | 0 | 0 | 12<br>21 | -<br>- | <0.1 | 0.7 | 2.5 | - |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VI (continued)

RESULTS OF ANALYSES FROM BEACH STATION 7

RICHARDSON BEACH

| SAMPLING DATE | SAMPLE TIME | PEOPLE | | BACTERIOLOGICAL ANALYSIS (MPN/100 ml) | | CHEMICAL ANALYSIS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | on Beach | in Water | Coliform | Fecal Coliform | ABS mg/1 | Turbidity T.U. | Cl mg/1 | $NO_3$ mg/1 |
| Wednesday 8-23-61 | 1135 | - | - | 50<br>62 | -<br>- | <0.1 | 2.1 | 2.0 | - |
| | 1556 | 160 | 50 | 210<br>230 | -<br>- | <0.1 | 3.6 | 2.0 | - |
| Thursday 8-24-61 | 1530 | 200 | 70 | 620<br>62 | -<br>- | <0.1 | 0.7 | 2.0 | - |
| Friday 8-25-61 | 0950 | 19 | 1 | 230<br>2300 | -<br>- | <0.1 | 0.6 | 3.0 | - |
| | 1420 | 175 | 40 | 23<br>13 | -<br>- | <0.1 | 1.2 | 2.0 | <0.5 |
| Monday 8-28-61 | 1015 | 10 | 2 | 62<br>6 | -<br>- | <0.1 | 0.5 | 2.0 | - |
| | 1515 | 0 | 0 | 62<br>23 | -<br>- | <0.1 | 0.7 | 2.0 | - |

Lake Tahoe Basin Water Quality Survey, 1961

## TABLE VII

### RESULTS OF BACTERIOLOGICAL ANALYSES

### MEDIAN COLIFORM DENSITIES
### AT POPULAR BEACHES
(MPN/100 ml)

| BEACH NUMBER | #1 | #2 | #3 | #3-X Surface | #3-X Roiled Bottom | #4 | #5 | #6 | #7 |
|---|---|---|---|---|---|---|---|---|---|
| ALL COLIFORM SAMPLES COLLECTED AT ALL STATIONS | 2300 | 700 | 620 | 620 | 620 | 620 | 620 | 2300 | 2300 |
| | 620 | 620 | 240 | 62 | 62 | 620 | 620 | 620 | 620 |
| | 230 | 620 | 230 | 23 | 23 | 620 | 620 | 620 | 230 |
| | 230 | 500 | 230 | <4.5 | 13 | 620 | 620 | 500 | 230 |
| | 62 | 240 | 230 | <4.5 | 4.5 | 500 | 240 | 500 | 210 |
| | 62 | 230 | 230 | <4.5 | <4.5 | 230 | 230 | 230 | 62 |
| | 62 | 230 | 230 | | | 230 | 230 | 230 | 62 |
| | 62 | 230 | 230 | | | 230 | 62 | 230 | 62 |
| | 62 | 230 | 230 | | | 62 | 50 | 23 | 62 |
| | 62 | 130 | 230 | | | 62 | 23 | 21 | 50 |
| | 62 | 62 | 230 | | | 23 | 23 | 12 | 23 |
| | 23 | 62 | 62 | | | 23 | 23 | 12 | 23 |
| | 6 | 23 | 23 | | | 23 | 23 | 12 | 13 |
| | 4.6 | 13 | <4.5 | | | 6 | 4.6 | 9.2 | 6 |
| MEDIAN VALUES | 62 | 230 | 230 | 13.8 | 18 | 230 | 146 | 230 | 62 |

Lake Tahoe Basin Water Quality Survey, 1961

TABLE VII (continued)

### RESULTS OF BACTERIOLOGICAL ANALYSES
### MORNING VS. AFTERNOON SAMPLING
### AT POPULAR BEACHES
### (MPN/100 ml)

| BEACH NUMBER | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| A.M. SAMPLES | 230 | 620 | 620 | 620 | 620 | 620 | 2300 |
| | 230 | 230 | 230 | 230 | 620 | 500 | 230 |
| | 62 | 62 | 230 | 230 | 240 | 500 | 62 |
| | 23 | 62 | 230 | 23 | 230 | 230 | 62 |
| | 6 | 23 | 23 | 23 | 23 | 12 | 50 |
| | 4.6 | 13 | 4.5 | 6 | 25 | 9.2 | 6 |
| MEDIAN VALUES | 43 | 62 | 230 | 127 | 235 | 365 | 62 |
| P.M. SAMPLES | 2300 | 700 | 240 | 620 | 620 | 2300 | 620 |
| | 620 | 620 | 230 | 620 | 620 | 620 | 230 |
| | 62 | 500 | 230 | 620 | 230 | 230 | 210 |
| | 62 | 240 | 230 | 500 | 62 | 230 | 62 |
| | 62 | 230 | 230 | 230 | 50 | 23 | 62 |
| | 62 | 230 | 230 | 62 | 23 | 21 | 23 |
| | 62 | 230 | 230 | 62 | 23 | 12 | 23 |
| | 62 | 130 | 62 | 23 | 4.6 | 12 | 13 |
| MEDIAN VALUES | 62 | 235 | 230 | 365 | 56 | 127 | 62 |

Special Beach Studies

Lake Tahoe Basin Water Quality Survey, 1961

## TABLE VIII

### MORNING VS. AFTERNOON MEDIAN VALUES OF TURBIDITY AND CHLORIDES

| | SAMPLE POINTS | | | | | | |
|---|---|---|---|---|---|---|---|
| BEACH NUMBER | #1 | #2 | #3 | #4 | #5 | #6 | #7 |
| (A) Turbidity Morning | 0.6<br>0.5<br>0.5 | 5.0<br>1.8<br>0.6 | -<br>-<br>- | 2.3<br>1.8<br>0.8 | 3.0<br>3.0<br>1.1 | 1.8<br>1.7<br>1.0 | 2.1<br>0.6<br>0.5 |
| A.M. MEDIAN VALUES | 0.5 | 1.8 | - | 1.8 | 3.0 | 1.7 | 0.6 |
| (B) Turbidity Afternoon | 2.5<br>1.8<br>1.2<br>1.2 | 7.0<br>5.7<br>57<br>- | -<br>-<br>-<br>- | 5.0<br>3.8<br>3.0<br>1.5 | 5.7<br>2.3<br>2.3<br>1.3 | 6.5<br>3.0<br>2.1<br>0.7 | 3.6<br>1.2<br>0.7<br>0.7 |
| P.M. MEDIAN VALUES | 1.5 | 7.0 | - | 3.4 | 2.3 | 2.6 | 1.0 |
| (A) Chlorides Morning | 2.5<br>2.5<br>2.0 | 3.0<br>3.0<br>2.5 | -<br>-<br>- | 3.0<br>2.5<br>1.5 | 2.5<br>2.0<br>- | 3.5<br>3.0<br>2.0 | 3.0<br>2.0<br>2.0 |
| A.M. MEDIAN VALUES | 2.5 | 3.0 | - | 2.5 | 2.2 | 3.0 | 2.0 |
| (B) Chlorides Afternoon | 3.0<br>3.0<br>2.5<br>2.5 | 3.0<br>3.0<br>2.5<br>- | -<br>-<br>-<br>- | 3.0<br>3.0<br>2.5<br>2.5 | 3.0<br>3.0<br>2.5<br>2.0 | 3.0<br>2.5<br>2.5<br>2.5 | 2.0<br>2.0<br>2.0<br>2.0 |
| P.M. MEDIAN VALUES | 2.7 | 3.0 | - | 2.7 | 2.7 | 2.5 | 2.0 |

shown in the following tables and are later discussed. All of the sampling data for the above studies were compiled to evaluate the general water quality conditions for each of the seven selected beaches along the Tahoe south shore. Conclusions drawn in this chapter pertain only to these beaches and do not imply that similar conditions existed at other beaches on the west and north shores.

Figure 10 shows the locations of the beach sampling stations in a sketch, and the descriptions of the beaches sampled are given in Table V.

### a. Discussion of Results

Tables VI and VII are summaries of the bacteriological and chemical results of samples collected at the seven selected beaches under study along the Lake Tahoe south shore. Tabulation shown below summarizes the data using median values in the study by Method A.

METHOD A

A.M. vs. P.M. Sampling

| TIME | MEDIAN VALUES FROM ALL STATIONS | | |
|---|---|---|---|
| | Coliform MPN/100 ml. | Turbidity T.U. | Chlorides mg/l |
| Morning (earlier than 10 A.M.) | 146 | 1.4 | 2.5 |
| Afternoon (later than 2 P.M.) | 230 | 2.3 | 2.5 |

(1) Morning vs. Afternoon Sampling (Method A) - The results show appreciable increases in coliform concentrations during the afternoon hours at popular beaches when compared to samples collected in the morning hours. The samples collected at Richardson Resort beach (Station 7) showed an exception to this trend.

Turbidity values rose consistently during the afternoon periods of sampling. These results were probably caused by combinations of afternoon winds and by greater boating and bathing activities. It is pointed out that the propeller turbulence of speedboats operating in shallow waters near marinas was creating clouds of turbidity in their wake. The level of the lake was very low in the 1961 summer season, and navigation was made difficult in marina areas because of the shallow waters. It was observed, however, that the settlement of turbid particles suspended by propeller agitation was quite rapid. In heavily used beach water that had been quite turbid during a preceding afternoon, water conditions were invariably quite clear the following morning. There appeared to be no change in chloride values during morning and afternoon sampling periods.

(2) Surface vs. Bottom Sampling (Method B) - Six coliform bacteria samples were collected from both the surface and the roiled bottom sediments at Station 3-X. Values at both points ranged from less than 4.5 to 620 MPN/100 ml. Median values for the surface and bottom samples were 14 and 18, respectively. From this minor difference in values, a conclusion cannot be drawn. The results tend to show that coliform organisms do not concentrate in bottom sediments at the one station studied.

(3) Synthetic Detergent (ABS) - A total of 41 samples was collected for ABS analysis and the results of all samples were less than 0.1 mg/l.

(4) Coliform vs. Fecal Coliform Comparisons - A total of 12 bacteriological samples was collected from the 7 beach study stations, and each of these samples was analyzed for both coliform and fecal coliform organisms in an attempt to differentiate between animal and soil bacteria. The results showed that the coliform analyses tended to be somewhat higher than the fecal coliform analyses, but the difference was not entirely consistent. From this, no conclusion can be drawn.

### 3. Sampling at Meeks Bay

Sampling results obtained during the early summer phase showed higher coliform bacteria levels at Meeks Bay, especially in the vicinity of beaches and boating facilities at the Meeks Bay Resort, than found elsewhere. Coliform levels, both north of Meeks Bay, past Sugar Pine Point, and south of the bay toward Rubicon, ranged in an average of 5 MPN/100 ml, but rose sharply to median values as high as 240 MPN/100 ml at the Meeks Bay Marina (Station 11). Turbidity samples collected during the same periods at the Meeks Bay sampling stations (Stations 9, 10, 11, 12) showed corresponding increases. Measurable values for ABS (0.1 and 0.2 mg/l) were found at beach stations 9 and 10. Because of these abrupt water quality changes at Meeks Bay, an additional day was devoted to collecting further samples in this area during the late summer phase of study. A sketch appearing in Figure 11 shows the selected sampling stations. Cursory sanitary inspections were made in the resort area to accompany the sampling data. Sampling results appear in Table IX.

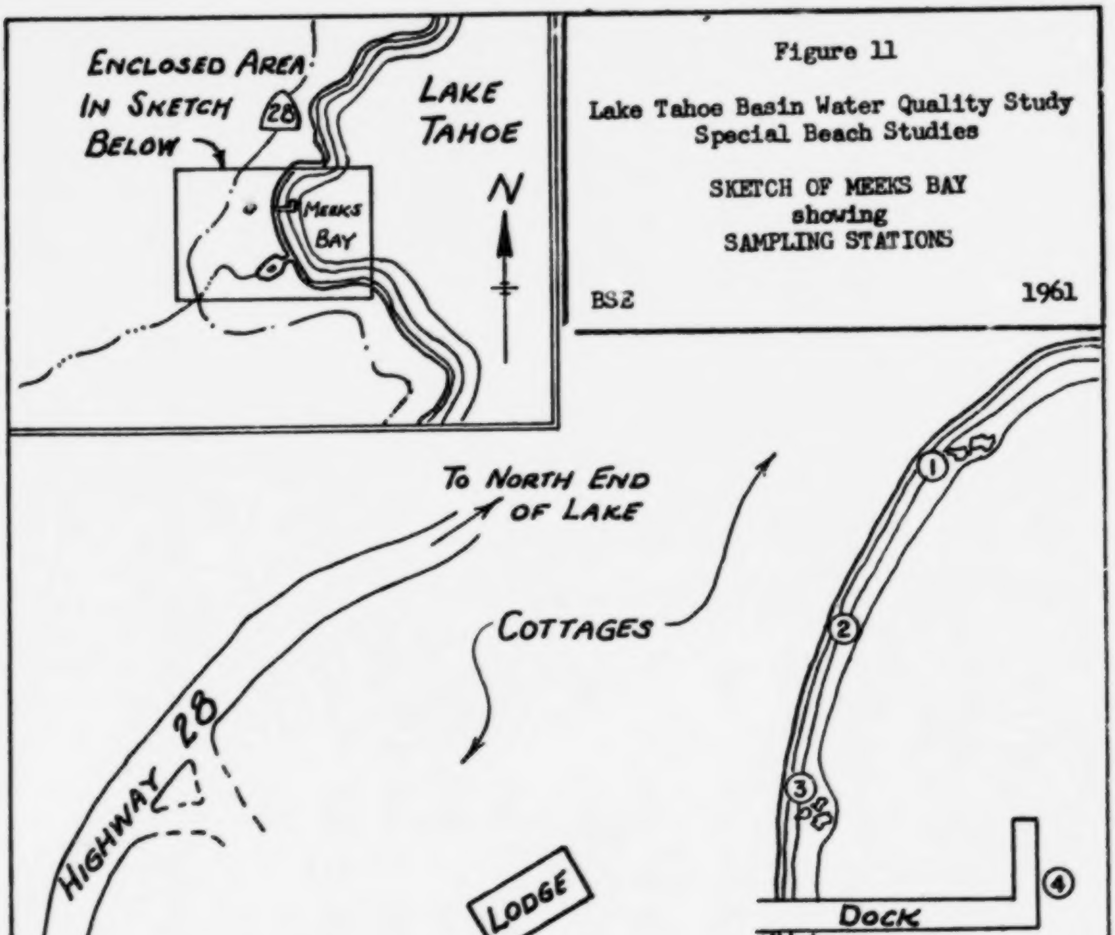
The present staff at the Meeks Bay Resort numbers about 50 persons, and the estimated guest population reaches about 1000 persons. Sewage disposal facilities here consist of cesspools and septic tanks with leaching beds. Rubbish and garbage are collected daily and burned at an approved area.

Figure 11

Lake Tahoe Basin Water Quality Study
Special Beach Studies

SKETCH OF MEEKS BAY
showing
SAMPLING STATIONS

BSE 1961


ENCLOSED AREA
IN SKETCH
BELOW
28
MEEKS
BAY
LAKE
TAHOE
N
TO NORTH END
OF LAKE
COTTAGES
HIGHWAY 28
LODGE
①
②
③
④
DOCK
MEEKS BAY
TRAILER
PARKING
⑤
⑥
ARTIFICIAL MARINA
MEEKS CREEK
⑦
SWIMMING
AREA
PARKING
⑧ CAMPGROUND TAP
CAMPING AREA
TO EMERALD BAY
N

## TABLE IX

## RESULTS OF SANITARY SURVEY INVESTIGATIONS AT MEEKS BAY
AUGUST 30, 1961

Party: Farr

Weather: Cloudy - Rain in Afternoon

| STATION DESCRIPTION | STATION NUMBER | TIME | COLIFORM MPN/100 ml | ABS mg/1 | CHLORIDE mg/1 | TURBIDITY T.U. | REMARKS |
|---|---|---|---|---|---|---|---|
| Near boulders at North end of beach | 1 | 1308 | <4.5 | 0.1 | 0.8 | 0.2 | No one on beach or in water |
| On beach opposite steps to beach | 2 | 1345 | 21 | 0.1 | 0.9 | 0.8 | No one on beach or in water |
| At boulders near Meeks Bay Wharf | 3 | 1347 | 240 | <0.1 | 0.9 | 0.5 | 15 on beach, 0 in water - some rain |
| Outer end of Marina Wharf | 4 | 1350 | 29 | <0.1 | 1.1 | 0.8 | |
| Gasoline dock in marina | 5 | 1450 | 700 | <0.1 | 0.6 | 1.3 | |
| In marina - lagoon | 6 | 1500 | 700 | <0.1 | 0.8 | 1.7 | |
| Swimming area and beach | 7 | 1515 | 130 | <0.1 | 1.2 | 0.5 | |
| Hose bib near parking lot, south of marina | 8 | 1530 | <4.5 | <0.1 | - | - | |

Meeks Creek had an appreciable flow during the early summer and was discharging into Lake Tahoe through a recently completed marina. Some dredging was being done at the mouth of the marina at this time, and turbidity observed in the water was quite pronounced. The marina has berth and mooring facilities for about 150 boats.

### a. Discussion of Results

During the one-day Phase II special study at Meeks Bay, coliform densities were lower than those found during the Phase I study. The synthetic detergent (ABS) results were below laboratory determinable levels at six stations; ABS levels of 0.1 mg/l were found at Stations 1 and 2. Chloride results were low, in a range from 0.6 to 1.2 mg/l.

The flow of Meeks Creek through the marina had almost ceased during this late summer investigation, and the dredging operation noted earlier had been completed. These factors may account, to a great extent, for the comparatively higher water quality condition here during the regular Phase II boat sampling period. Median coliform values at these same stations dropped to less than 4.5 MPN/100 ml in Phase II, and turbidity values were correspondingly low.

The results indicated that swimming, bathing and boating activities tend to raise coliform bacteria and water turbidity levels in this rather confined area above the levels in the lake receiving less use.

The higher values obtained here during the early summer study probably resulted from the flow of Meeks Creek through the Marina Lagoon and by the daily dredging operation at the mouth of the marina.

## E. INTAKE AND DEPTH STUDIES

Additional water quality measurements were made at Lake Tahoe which were supplementary to the principal objective of this survey. Intake and depth investigations were concerned with finding some assay in the distribution of coliform bacteria at various lake depths, and with increments of distance offshore. These studies were referenced with some of the more prominent water supply intakes. Specifically, three comparisons of coliform distribution were made as follows:

> Coliform Concentration vs. Zones of Depth - Incorporated into the procedure of sampling by boat on Lake Tahoe was the routine collection of bacteriological samples at each station from the lake surface and near the bottom. The coliform results obtained were sorted into zones of depth in an attempt to find if densities of bacteria tend to differ at certain lake depths. The data thus obtained are shown in Table X, and Figure 12 is a graphical representation of the findings.

Coliform Concentration vs. Depth and Type of Local Water Activity - It was noted from early summer return of bacteriological data that increases in coliform concentrations were often found in lake waters (1) at popular beaches, (2) at marinas and piers, and (3) at the mouths of rivers and creeks. The data were assembled into categories of water use and according to bacterial density and water depth. Similar comparisons of data were assembled from data at a station having the least possible natural, or human, influence. Figure 13 shows these results graphically in a 3-dimensional concept (i.e., coliform concentration vs. depth, vs. type of local water activity).

Coliform Concentration vs. Distance Offshore at Water Supply Intakes - Additional bacteriological samples were collected at some of the prominent public water supply intakes at Lake Tahoe. These samples were collected directly over the mouth of the intakes, both from the surface and from the bottom, and from increments of distance offshore. For example, one would expect to find coliform concentrations diminishing as sampling was extended to greater depths and to greater distances offshore from shoreline influences. The data assembled from this concept of study are summarized in Table XI.

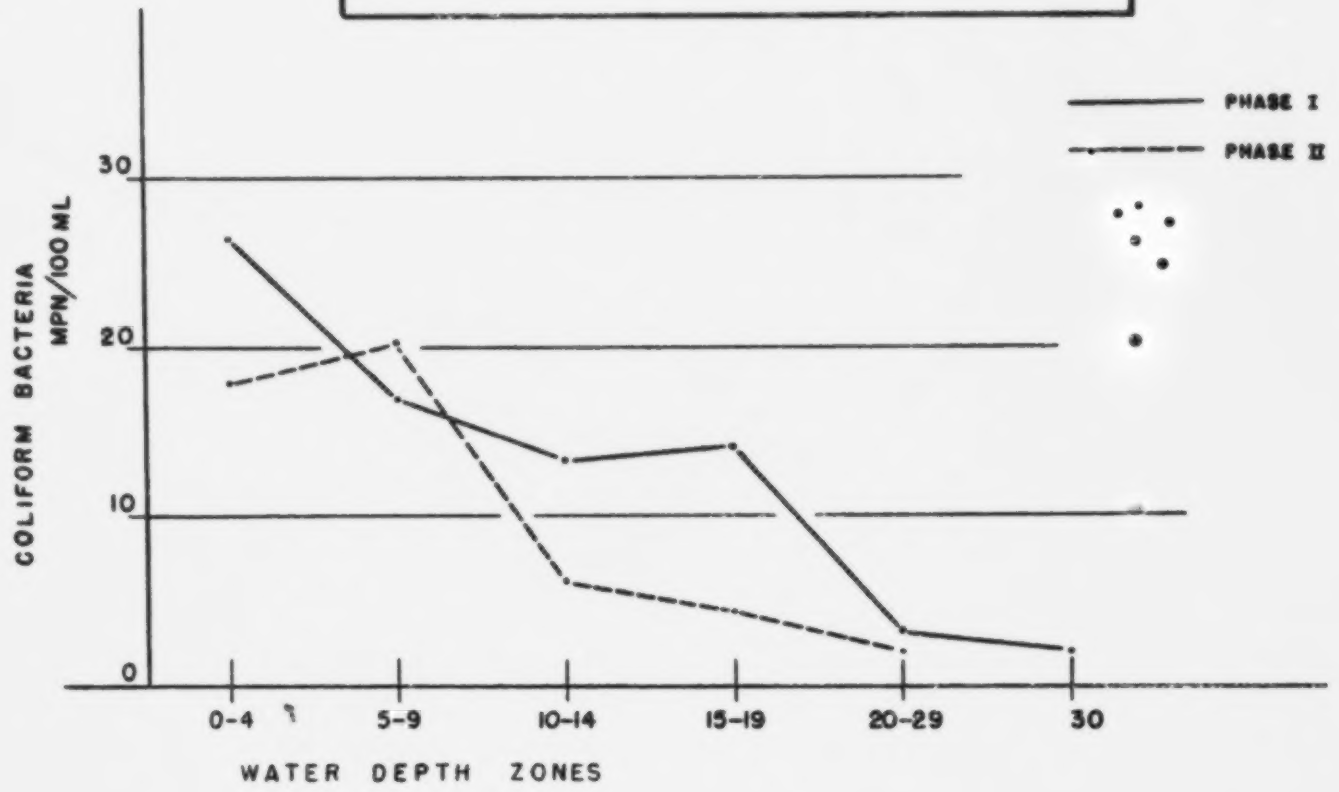
TABLE X

VARIATION OF BACTERIOLOGICAL QUALITY
VS. ZONES OF DEPTH
ALL STATIONS ON LAKE TAHOE

| RANGES OF DEPTH | AVERAGE MPN/100 ml. - COLIFORM BACTERIA | | | | | |
|---|---|---|---|---|---|---|
| | Surface - 4' | 5' - 9' | 10' - 14' | 15' - 19' | 20' - 29' | >30 |
| Phase I | | | | | | |
| No. of Samples | 378 | 76 | 49 | 21 | 24 | 13 |
| Avg. MPN/100 ml. | 26.4 | 16.8 | 13.2 | 14.0 | 3.2 | 2.0 |
| Phase II | | | | | | |
| No. of Samples | 442 | 75 | 32 | 20 | 9 | - |
| Avg. MPN/100 ml. | 17.8 | 20.2 | 6.2 | 4.4 | 2.1 | - |

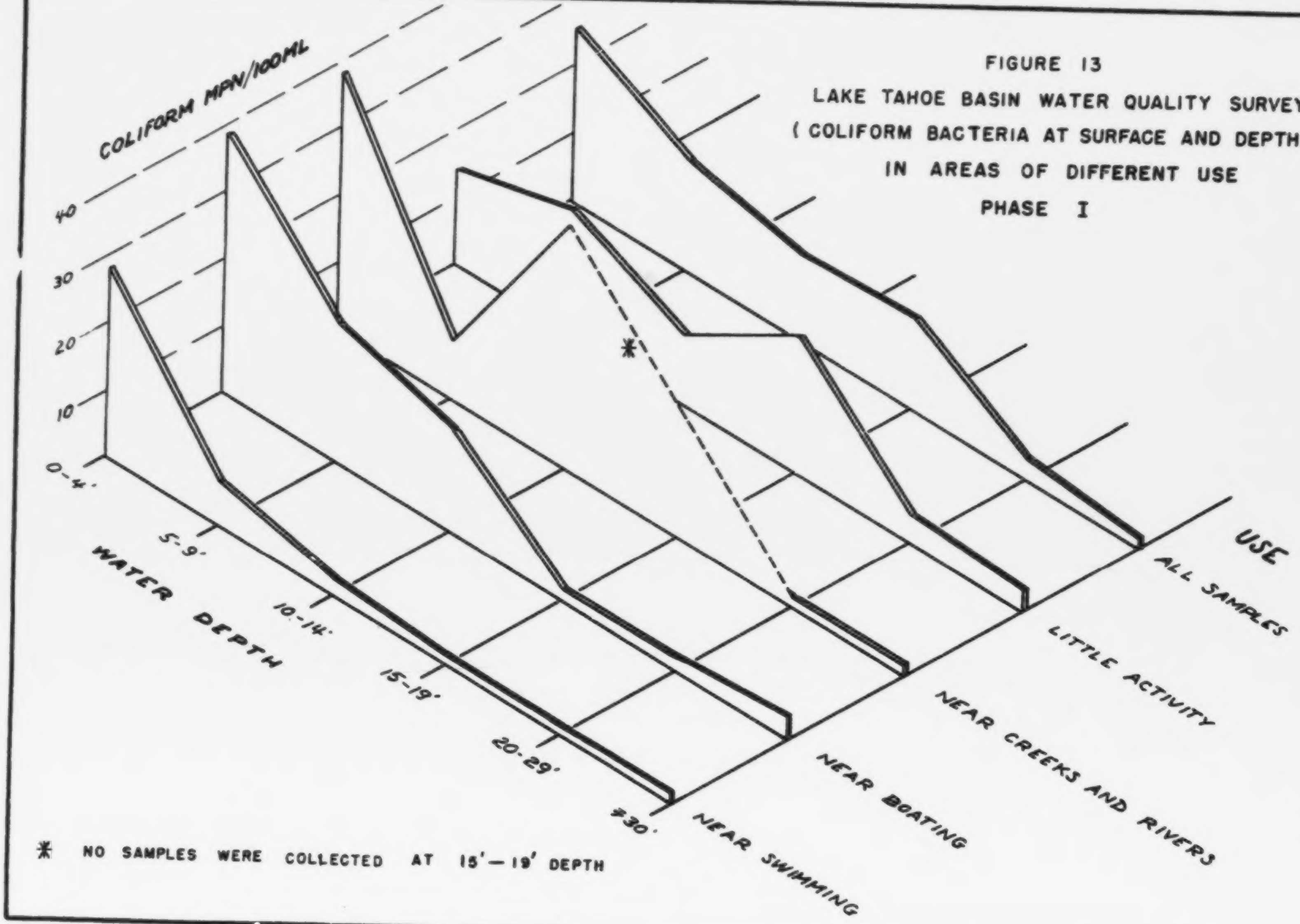
FIGURE 12

LAKE TAHOE BASIN WATER QUALITY STUDY
BACTERIOLOGICAL QUALITY VS. WATER DEPTH
IN LAKE TAHOE



## FIGURE 13

LAKE TAHOE BASIN WATER QUALITY SURVEY
( COLIFORM BACTERIA AT SURFACE AND DEPTH )
IN AREAS OF DIFFERENT USE
PHASE I



* NO SAMPLES WERE COLLECTED AT 15'— 19' DEPTH

## 1. Discussion of Results

a. Bacteriological Quality vs. Water Depth. During both phases of the sampling program, sufficient numbers of bacteriological samples were collected both at the water surface and at various depths to permit an evaluation of changes in the bacteriological quality of Lake Tahoe water with changes in water depth.

Because of the low level of coliform bacteria in many of the samples collected, the results of analysis were often indeterminate and were reported in Phase I as MPN less than 2.2. In Phase II of the study, where a different number of fermentation tubes were used in the analysis, these indeterminate values were reported as MPN less than 4.5. In order to include the results of these samples in determining average MPN values of the coliform bacteria, the indeterminate values were considered as zero MPN/100 ml. Samples were separated by the depth at which they were collected. The averages of samples collected from the following levels were computed:

Surface - 4'
5' - 9'
10'- 14'
15'- 19'
20'- 29'
and >30'

The average coliform MPN values for Phase I and Phase II at these levels are plotted in Figure 12.

It is apparent from the Figure that the waters near and at the surface contain the higher concentrations of coliform bacteria. The average MPN values for Phase I showed a fairly straight line decrease with increased depth. The average values of Phase II indicated a sharp decrease in coliform bacteria between the 5 to 9 foot, and the 10 to 14-foot depths. In both phases, the coliform content of the water reached a low level at a depth of from 20 to 29 feet.

b. Bacteriological Quality vs. Water Uses vs. Variations in Depth. The coliform bacteria results of Phase I were separated into four categories: those collected in areas of little use, in boating areas, in swimming areas, and in creeks and rivers. The average MPN values for the depth intervals previously described were computed. The averages are shown in Figure 13. In areas of little use, there was no definite coliform peak at the surface such as that which appeared in the coliform profiles of other areas. This would suggest that boating and swimming activities, as well as the local influence of creeks and rivers, cause higher levels of coliform bacteria at the surface in Lake Tahoe waters. Profiles in all areas showed that the coliform bacteria concentrations decreased as the depth increased. At depths from 20 to 29 feet, a low coliform bacteria level was reached in all areas, and little further reduction was noted.

c. Bacteriological Quality vs. Offshore Distance. The relationship between bacteriological quality and distance from the shore was investigated, using Lake Tahoe sampling data. The average values of coliform density for samples collected within different intervals of distance offshore were computed. A summary is shown below.

### TABLE XI

### BACTERIOLOGICAL QUALITY VS. OFFSHORE DISTANCE

| Distance Offshore | Number of Samples | Average Coliform MPN/100 ml |
|---|---|---|
| < 50 feet | 92 | 38.6 |
| > 50 feet - 150 feet | 167 | 15.2 |
| >150 feet - 300 feet | 70 | 10.6 |
| >300 feet - 750 feet | 39 | 53.9 |
| >750 feet* | 10 | 59.6* |

An inspection of the data indicates that there is no apparent relationship between the coliform bacteria and the offshore distances.

*The higher average found more than 750 feet from the shore was caused by the inclusion of the results of five samples collected 1800 feet from the mouth of the Upper Truckee River. Results of other samples collected at distances greater than 750 feet from the shore were uniformly low.

d. Bacteriological Quality at Domestic Water Supply Intakes. Special studies were carried out to determine the quality of water in areas where it is diverted for domestic use. Bacteriological samples were collected at six domestic water supply intakes from the water surface and near the lake bottom. The median values of coliform bacteria are shown below.

### TABLE XII

### BACTERIOLOGICAL QUALITY AT WATER SUPPLY INTAKES SURFACE AND BOTTOM COMPARISONS

| NAME OF WATER COMPANY INTAKE | MEDIAN COLIFORM MPN/100 ml | |
|---|---|---|
| | Surface | Bottom |
| Tahoma | 6 | 7.2 |
| Connolly's Resort | <4.5 | <4.5 |
| Brockway Water Co. | <4.5 | 7.4 |
| Cottonwood Motel | <4.5 | <4.5 |
| Dollar Point | <2 | <2 |
| Tahoe City | 2.2 | <2 |

The results indicate that there is no significant difference between water quality at the surface and at the lake bottom near the water intakes. The coliform bacteria concentrations were low at both places.

Samples were also collected at intervals of 50 feet and 100 feet offshore from the intakes in order to determine if the water quality changes further offshore. The median values of these results are arranged in the table below.

## TABLE XIII

### BACTERIOLOGICAL QUALITY AT WATER SUPPLY INTAKES
### WATER OVER INTAKES VS.
### WATER FURTHER OFFSHORE

Median Coliform MPN/100 ml

| | | DISTANCES FROM SHORE LINE | | | | | |
|---|---|---|---|---|---|---|---|
| STATION NO. | WATER INTAKE | Intake | 50 ft. | 100 ft. | 150 ft. | 200 ft. | 300 ft. |
| 51B | Brockway | <4.5 | - | <4.5 | - | <4.5 | <4.5* |
| 59 | Dollar Point | <4.5 | <4.5 | <4.5* | - | <4.5* | - |
| 63 | Tahoe City | <4.5 | 6* | <4.5 | <4.5* | <4.5 | <4.5* |
| 66 | Sunnyside | 23 | <4.5* | <4.5 | <4.5 | - | - |

*Denotes a single sample.

The only difference found in coliform densities between intake and offshore stations was noted at Station No. 66. Elsewhere, it appears that no significant difference in bacteriological quality existed between the water at the intakes and waters further offshore.

## II. WELL, STREAM AND SPRING SAMPLING PROGRAM

The survey crew also sampled at wells, streams and springs in the Tahoe Basin to determine to what extent, if any, these water supplies were being affected by waste disposal practices. All possible effort was made to collect samples from each selected source during both the early and late summer study phases for purposes of comparison. The local health departments gave valuable assistance in suggesting the places where the best representative sampling might be done. Attention was given to sampling in neighborhoods and at specific places where sewage disposal systems have been known to fail in the past.

Routinely, samples were collected from surface and underground sources in the vicinity of the community sewage treatment plants to determine if their disposal practices were affecting the quality of these adjacent waters.

The entire Basin area was divided into geographical divisions or sectors of territory, for convenience in planning, and in the reporting of findings. The three major divisions of study are as follows:

Upper Truckee River and Bijou Creek. The streams tributary to the Upper Truckee River were of special interest in view of the water quality objective of this survey because of the rather intensive human activities on this watershed. Analyses obtained during the early summer study phase showed higher orders of chemical and bacteriological results in these surface waters. The same was true of Bijou Creek. Special sampling and survey emphasis was devoted to the study of these streams in order to fully assess their water quality conditions, and to find possible sources which may have been contributing to the changes in water quality.

Lower Truckee River Sampling Program. The selection of sampling stations for the Lower Truckee River investigations began at the outlet of Lake Tahoe at Tahoe City, and continued progressively downstream to the final station at Farad. Combined with this program were included water quality surveys in Squaw Valley and in the Donner-Truckee area.

Sector Studies. The territory surrounding the shores of Lake Tahoe, within California, was divided into fourteen geographical "sectors" for planning and reporting convenience. Representative wells, streams and springs were sampled in each sector, both during the early and late summer study phases for purposes of comparison.

### A. UPPER TRUCKEE RIVER AND BIJOU CREEK SAMPLING PROGRAM

#### 1. Introduction

The chart which follows in Figure 14 shows the established sampling stations along the Upper Truckee River, Trout Creek, Heavenly Valley Creek, Cold Creek and Bijou Creek. Although Bijou Creek has a separate watershed and is not tributary to the Truckee River, it was

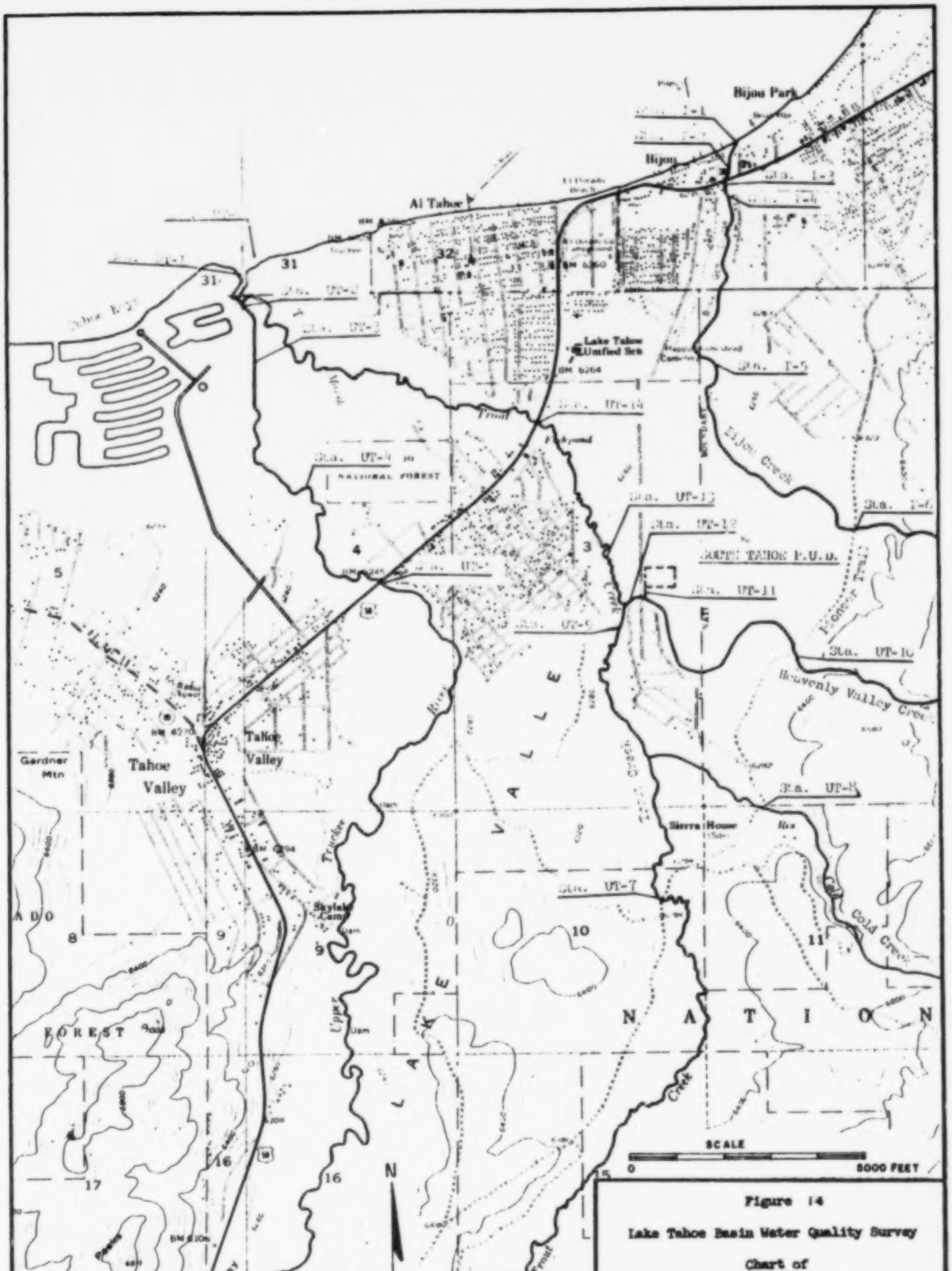

Bijou Park
Sta. I-1
Sta. I-2
Bijou
Sta. I-3
Sta. I-4
Al Tahoe
Sta. UT-1
31
32
Sta. UT-2
Sta. UT-3
Lake Tahoe Unified Sch
Sta. I-5
Sta. UT-14
Trout
Bijou Creek
Sta. UT-4
NATIONAL FOREST
Sta. I-6
Sta. UT-13
Sta. UT-12
SOUTH TAHOE P.U.D.
4
3
5
Sta. UT-5
Sta. UT-11
Sta. UT-9
Pioneer Trail
Sta. UT-10
Heavenly Valley Creek
Gardner Mtn
Tahoe Valley
Tahoe Valley
Sta. UT-8
Sierra House
Upper Truckee River
Sta. UT-7
Skylake Camp
8
9
9
10
11
Cold Creek
LAKE VALLEY
FOREST
NATION
Trout Creek
16
16
17
N
Lake Valley
20
Sta. UT-6
21
22
15
SCALE
0
5000 FEET

Figure 14

Lake Tahoe Basin Water Quality Survey

Chart of

UPPER TRUCKEE RIVER and BIJOU CREEK

showing SAMPLING STATIONS

BSE 1961

## TABLE XIV

## UPPER TRUCKEE RIVER SAMPLING DATA

| STATION AND DESCRIPTION | PHASE I | | | | | | PHASE II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | NO$_2^-$ (mg/1) | NO$_3^-$ (mg/1) | PO$_4$ (mg/1) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | Cl$^-$ (mg/1) | NO$_3^-$ (mg/1) | PO$_4$ (mg/1) |
| UT-0 Mouth, Upper Truckee River, 50' offshore | 240[a] | <0.1 | 2.5 | | | | | | | | | |
| UT-1 Upper Truckee River, 200'-800' upstream from mouth, west shore | 240[b] | <0.1 | 13.5 | | | | 620 | <0.1 | 1.4 | 3.0 | | <.01 |
| | 240 | - | 6.1 | | | | 13 | | | | | |
| | 240 | | | | | | 29 | | | | | |
| | >240 | - | 19.0 | | | | E.C. 6 | | | | | |
| | 38 | | | | | | | | | | | |
| UT-2 Upper Truckee River, about mouth of Trout Creek | 240[c] | <0.1 | 9.5 | | | | | | | | | |
| | 240 | - | 8.0 | | | | | | | | | |
| | 38 | | | | | | | | | | | |
| | 240 | - | 9.9 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| UT-3 Upper Truckee River, 300'-1000' above Trout Creek | >240[d] | | 10.3 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | 6.2 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | 5.3 | | | | | | | | | |
| | 240 | | | | | | | | | | | |

[a] Scum at shoreline; shoreline littered with cans, papers and prophylactics.
[b] Water gray and murky. East shore - pasture.
[c] Excavation in creek. Trout Creek runs through pasture. (Phase I.)
[d] Water murky.

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XIV (continued)

| STATION AND DESCRIPTION | PHASE I | | | | | | PHASE II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_2^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $Cl^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) |
| UT-4 Upper Truckee River, 3500'-5500' from mouth | 38 | | 5.3 | | | | NO SAMPLES COLLECTED | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | 5.3 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | >240 | | 5.6 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | >240e | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240e | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | >240 | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| TAHOE KEYS: | | | | | | | | | | | | |
| New well | - | <0.1 | 13.5 | | | | | | | | | |
| Landlocked lagoon receiving well discharge | - | 0.2 | 172 | | | | | | | | | |
| Inside Marina Harbor | - | <0.1 | 13.5 | | | | | | | | | |

e Water murky below tributary.

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XIV (continued)

| STATION AND DESCRIPTION | PHASE I | | | | | | PHASE II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_2^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $Cl^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) |
| UT-5 Upper Truckee River, at U.S. 50 Bridge | | | | | | | 620 | <0.1 | 1.2 | 4.0 | - | - |
| | | | | | | | 62 | | | | | |
| | | | | | | | E.C. 62 | | | | | |
| | | | | | | | Plankton and Algae = 960 per ml | | | | | |
| NE Corner | -[f] | <0.1 | 30.0 | .0001 | 1.0 | - | | | | | | |
| | 240 | | 9.9 | | | | | | | | | |
| | 38 | | | | | | | | | | | |
| NW Corner | 240 | - | 10.5 | - | - | - | | | | | | |
| | 240 | | | | | | | | | | | |
| SE Corner | 240[g] | <0.1 | 9.5 | - | - | 0.30 | | | | | | |
| | >240 | | | | | | | | | | | |
| | 96 | - | 3.8 | | | | | | | | | |
| | 240 | | | | | | | | | | | |
| | Plankton and Algae = 2900 per ml | | | | | | | | | | | |
| SW Corner | 38 | - | 4.5 | - | - | - | | | | | | |
| | >240 | | | | | | | | | | | |
| | - | <0.1 | 3.0 | | | | | | | | | |
| UT-6 Upper Truckee River, at Hwy. 89 | 240[h] | <0.1 | 2.5 | - | - | 0.15 | 1300 | <0.1 | 0.6 | - | - | - |
| | 240 | | | | | | | | | | | |
| UT-7 Trout Creek at Pioneer Trail | | | | | | | >2400 | <0.1 | 1.2 | 1.0 | <0.5 | |
| | Plankton and Algae = 860 per ml | | | | | | 220 | | | | | |
| | | | | | | | 230 | <0.1 | | 1.0 | | |
| | | | | | | | E.C. 62 | | | | | |

[f] Excavation at NE side of bridge. Drain pipe in creek.

[g] Water murky; trash pile under bridge.

[h] Water murky; sandy bottom; sluggish flow.

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XIV (continued)

| | PHASE I | | | | | | PHASE II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION AND DESCRIPTION | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_2^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $Cl^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) |
| UT-8 Cold Creek at Pioneer Trail | | | | | | | >2400<br>2400<br>E.C.230 | <0.1 | 7.5 | 1.0 | - | - |
| UT-9 Trout Creek at Martin Avenue | >240<br>240<br>240 | <0.1<br><0.1 | -<br>9.5 | 0 | - | <br>0.12 | 500<br>>2400<br>E.C. 23 | <0.1 | 1.9 | 1.0 | - | - |
| | Plankton and Algae = 770 per ml; Amorphous Material. | | | | | | | | | | | |
| UT-10 Heavenly Valley Creek at Pioneer Trail | >240<br>240 | <0.1 | - | 0 | - | - | 62<br>230<br>E.C. 23 | <0.1 | 2.3 | 1.0 | - | - |
| UT-11 SW Corner, S.T.P.U.D. Seepage | Sludge Bed #1 | | | | | | 230 | 3.2 | - | - | - | |
| | Sludge Bed #2 | | | | | | <4.5 | 3.2 | | 44.5 | - | |
| | Sludge Bed #3 | | | | | | <4.5 | 3.6 | | - | - | |
| | Sludge Bed #4 | | | | | | 230 | 3.6 | | - | - | |
| | Embankment west | | | | | | 230 | 0.9 | | 39.0 | - | |
| | Culvert, north of office | | | | | | >24,000 | 5.0 | | 43.0 | <0.5 | |
| | Drain tile, 50' west | | | | | | 62 | 0.6 | | 40.0 | 1.2 | |
| | Combined drain, 50' below culvert | | | | | | 7000 | 0.6 | | 32.0 | 1.1 | |
| UT-12 Heavenly Valley Creek, at Trout Creek | >240<br>>240 | <0.1<br><0.1 | -<br>6.0 | - | - | - | >2400[1]<br>>2400<br>E.C.2400 | 1.0 | 2.5 | 21.0 | - | - |

[1] Water foaming.

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XIV (continued)

| STATION AND DESCRIPTION | | PHASE I | | | | | | PHASE II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_2^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $Cl^-$ (mg/1) | $NO_3^-$ (mg/1) | $PO_4$ (mg/1) |
| UT-13 | Trout Creek, below Heavenly Valley Creek | 240 | <0.1 | - | 0 | <0.5 | - | >2400[j] | <0.1 | 1.4 | 1.5 | - | - |
| | | | | | | | | 2400 | <0.1 | - | 1.5 | <0.5 | |
| | | | | | | | | 2400 | | | | | |
| | | | | | | | | E.C. 230 | | | | | |
| UT-14 | Trout Creek, at U.S. 50 Bridge | | | | | | | 2400 | <0.1 | 1.5 | 2.0 | | 0.02 |
| | | | | | | | | 2400 | | | 2.0 | | |
| | | | | | | | | 62 | <0.1 | - | 1.5 | <0.5 | |
| | | | | | | | | 23 | <0.1 | 0.4 | 0.3 | | |
| | | | | | | | | 230 | | | | | |
| | | | | | | | | E.C. 620 | | | | | |
| | | | | | | | | Plankton and Algae = 510 per ml | | | | | |
| | SW Corner | >240[k] | - | 10.4 | - | - | - | | | | | | |
| | | >240 | | | | | | | | | | | |
| | SE Corner | >240 | - | 5.3 | - | - | - | | | | | | |
| | | >240 | | | | | | | | | | | |
| | | - | <0.1 | 6.0 | 0 | - | - | | | | | | |
| | NW Corner | >240 | - | 8.8 | - | - | - | | | | | | |
| | | >240 | | | | | | | | | | | |
| | NE Corner | 240[l] | <0.1 | - | 0 | - | | | | | | | |
| | | >240 | <0.1 | 7.5 | | | 0.22 | | | | | | |
| | | 240 | | | | | | | | | | | |
| | | 38 | <0.1 | 6.0 | | | | | | | | | |
| | | 96 | - | 5.3 | | | | | | | | | |
| | | >240 | | | | | | | | | | | |
| | | Plankton and Algae = 850 per ml | | | | | | | | | | | |

[j] Cow manure near creek.
[k] Construction at south side of bridge.
[l] Water murky; sandy bottom.

## TABLE XV

### BIJOU CREEK SAMPLING DATA

| STATION AND DESCRIPTION | PHASE I (JUNE 22 - 25) | | | | | PHASE II (AUGUST 28) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/l) | Turb. (T.U.) | PO$_4$ (mg/l) | Plankton & Algae (per ml) | Coliform (MPN/100 ml) | ABS (mg/l) | Turb. (T.U.) | Cl$^-$ (mg/l) | PO$_4$ (mg/l) | Plankton & Algae (per ml) |
| 1-B Mouth, Bijou Creek | >240 | <0.1 | 12.5 | - | | >24,000[a] | 0.2 | 1.8 | 3.5 | 0.22 | 51 |
| | >240 | | | | | >2400 | | | | | |
| | | | | | | E.C.2400 | | | | | |
| | | | | | | | Prominent species: Euglena | | | | |
| 2-B Bijou Creek at Shopping Center | >240[b] | <0.1 | 3.0 | 1.52 | 980 | | | | | | |
| | >240 | | | | | | | | | | |
| 3-B Bijou Creek at U.S. 50 (gas station) | >240 | <0.1 | 1.5 | - | | >2400[c] | - | - | - | - | |
| | >240 | | | | | 700 | | | | | |
| | | | | | | E.C. 620 | | | | | |
| 4-B Bijou Creek, below golf course | >240 | <0.1 | 2.5 | - | | 1300 | <0.1 | 0.8 | 1.0 | - | |
| | >240 | | | | | >2400 | | | | | |
| 5-B Bijou Creek, above golf course | >240 | <0.1 | 1.5 | - | | 7000 | <0.1 | 2.2 | 1.0 | - | |
| | >240 | | | | | 2400 | | | | | |
| | 240 | <0.1 | 2.5 | - | | E.C.1300 | | | | | |
| | 240 | | | | | | | | | | |
| 6-B Bijou Creek, at Pioneer Trail | 38 | <0.1 | 5.0 | - | | | | | | | |
| | 240 | | | | | | | | | | |
| | 240 | <0.1 | 3.0 | - | | | | | | | |
| | 240 | | | | | | | | | | |
| | 240 | <0.1 | 3.0 | - | | | | | | | |
| | 240 | | | | | | | | | | |

[a] Creek dammed up; no flow.

[b] Creek unsightly and foul smelling. Gasoline film on water; trash on shore.

[c] No flow; banks littered with paper. Dead fish in water.

studied carefully because of its adverse water quality effect upon its discharge into Lake Tahoe. (See Lake Tahoe waters sampling data and refer to the results obtained at Station 32 on Figure 7.)

During the first week of sampling along the south shores of Lake Tahoe in June 1961, it was immediately apparent that a fan of turbid waters persisted daily off the mouth of the Upper Truckee River. This turbid band extended out into the lake for distances up to 600 yards, and its movement was eastward toward Bijou and Stateline. When sampling in this belt of turbid waters, the results of coliform bacteria sampling were usually in higher ranges. It appeared certain that the discharge of the Truckee River was not only causing turbidities in Lake Tahoe waters, but was also contributing very largely to higher coliform bacteria levels.

This sampling program was expressly concerned with locating the causes of the turbid discharge of the Truckee River and with its measurable water quality conditions. Table XIV summarizes the data obtained for stations along the Upper Truckee River and its tributaries, and Table XV lists the data obtained from sampling along Bijou Creek.

## 2. Discussion of Results - Upper Truckee River Sampling Program

a. Coliform Bacteria and Turbidity. During the Phase I period of study, median values of coliform samples collected at Stations UT-0, UT-1 and UT-2 at the mouth of the Upper Truckee River were all 240 MPN/100 ml. The turbidities at these stations ranged from 2.5 to 19.0 T.U. Observations made at the time of sampling included: shoreline littered with cans; paper and trash; water gray and murky; Trout Creek passes through a cattle pasture. Large particles of cattle manure were washed to shore on a sand bar at the mouth of the Truckee River.

Coliform values persisted in the range of 240 MPN/100 ml upstream from 300 to 1000 feet above the Trout Creek confluence at Station UT-3. Turbidities at this station ranged from 5.3 to 10.3 T.U. Station UT-4 is about a mile upstream from the mouth of the river and sixteen coliform samples collected here showed values of 240 MPN/100 ml or greater. Turbidities ranged from 5.3 to 5.6 T.U.

Another series of coliform samples was collected at the U. S. Highway 50 bridge crossing over the Upper Truckee River at Station UT-5. Again, coliform values were in the order of 240 MPN/100 ml, but turbidity values showed increases to 30 T.U. Survey notes report that deep excavations were being made at the site of the bridge crossing for sewer construction, and that pumps were being operated during the work hours to dewater the excavations. The pumps were discharging to the Upper Truckee River and were creating great quantities of light brown silt which could be seen washing downstream toward Lake Tahoe. For a comparison, the turbidity values at the undisturbed upstream Station UT-6 were only 2.5 T.U.

A plankton sample collected at Station UT-5 during the first phase had a density of 2900 per ml, while a sample collected here in Phase II was 960 plankton per ml.

Other upstream stations on tributary creeks showed coliform values in the range of 240 MPN/100 ml, but with much lower turbidities than those reported at the site of the excavation at Highway 50. At station UT-14 (Trout Creek at U. S. 50 Bridge, SW), the coliform values were greater than 240 MPN/100 ml, and the turbidity here was 10.4 T.U. It was noted also that crewmen were constructing a pipeline crossing over the creek and were standing in the stream bed while working. Silt could be seen washing downstream from this site. The first phase plankton density here was 850 per ml.

Higher dilutions were made for coliform samples collected at these stations during the late summer sampling phase. Values along Trout Creek and Heavenly Valley Creek were often greater than 2400 per 100 ml, and highest single values reached greater than 24,000 per 100 ml. The turbidities throughout Trout Creek and the Truckee River showed marked reductions in Phase II. In the late summer the stream flows had almost ceased, and the construction work noted previously had been completed. It is noteworthy that the turbidity at the mouth of the Upper Truckee River at Station UT-1 dropped to 1.4 T.U. in September.

A new well was being drilled for the Tahoe Keys development in the early summer, and large quantities of drilling mud and silt were being discharged to a landlocked lagoon very near the mouth of the Truckee River. There was no overflow of this turbid water to the river, however. The turbidity in the lagoon was 172 T.U., and 13.5 T.U. was recorded inside the Tahoe Keys Marina. Results of sampling indicated that activities at the Tahoe Keys development were not adding appreciable quantities of turbidity or bacterial concentrations in Lake Tahoe. The comparisons of results do show that the early summer construction activities and the grazing of cattle in the delta meadows were contributing greatly to the existence of turbid waters with higher coliform densities in Lake Tahoe, off the mouth of the Upper Truckee River.

b. Synthetic Detergent (ABS). Many ABS samples were collected at the stations shown in Figure 14, and the data show negative results at all stations except at Station UT-11, which was located at the point of seepage flow at the southwest corner of the South Tahoe P.U.D. sewage treatment plant. While coliform densities varied greatly here, ABS values from eight samples collected during Phase II ranged from 0.6 to 5.0 mg/1. An ABS sample directly downstream at the junction of Trout and Heavenly Valley Creeks showed 1.0 mg/1, and water foaming was noted.

c. Chloride. Chloride determinations were made during the Phase II study, and values were in the order of 1.0 to 2.0 mg/1 at most stations on this watershed, except for those samples collected from the seepage at the South Tahoe P.U.D. sewage treatment plant and areas downstream. Chlorides at Station UT-11 near the plant ranged from 32 to 44.5 mg/l in five samples. Downstream, at Station UT-12, the chloride was 21.0 mg/l. The chloride values dropped progressively downstream on Trout Creek from 4.0 mg/l at Station UT-5 to 3.0 mg/l at Station UT-1, which is near the mouth of the Upper Truckee River. Chloride values above the treatment plant in Heavenly Valley, Cold, and Trout Creeks were consistent at 1.0 mg/l.

The data show there is some evidence that drainage containing sewage was flowing from the South Tahoe P.U.D. treatment plant and was reaching the waters of Heavenly Valley and Trout Creeks. Because of considerable downstream dilution, the data does not show conclusively that the sewage was reaching the waters of Lake Tahoe.

d. Nitrite, Nitrate and Phosphate. A few samples were collected for these determinations. All results were relatively low. Nitrate values at the seepage below the South Tahoe P.U.D. sewage treatment plant were <0.5, 1.2 and 1.1 mg/l for three samples collected. The phosphate was 0.22 mg/l at the Trout Creek crossing of U. S. Highway 50.

The sampling data of all determinations show that the seepage emanating from the South Tahoe P.U.D. sewage treatment plant is influencing the water quality downstream. Dilution and other factors tend to reduce this influence by the time the flows reach Lake Tahoe, however.

### 3. Discussion of Results - Bijou Creek Sampling Program

Table XV summarizes the results of sampling along Bijou Creek. Its watershed is separate from that of the Upper Truckee River areas. The Lake Tahoe boat sampling program had shown marked increases in both turbidity and coliform bacteria populations at the point of discharge of Bijou Creek (Lake Station 32).

Bijou Creek flows through a golf course, through cattle pastures, and through areas of active building developments in its course. It crosses U. S. Highway 50 in Bijou where there are a great many commercial developments.

The data results for Sampling Station 32 in the Lake Tahoe sampling program show that the discharge of Bijou Creek into the waters of Lake Tahoe created significant increases in color, turbidity and coliform concentrations. The discussions of additional sampling data which follow amplifies the conclusion that the discharge of Bijou Creek is affecting the water quality in Lake Tahoe.

a. Coliform Bacteria and Turbidity. Coliform densities during both phases of study were in high ranges. Phase II samples were

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greater than 2400 MPN per 100 ml in numerous samples. Turbidities ranged from 1.5 T.U. in upstream areas to 12.5 T.U. at the mouth (Station 1-B). Turbidities fell appreciably in Phase II when the stream almost ceased flowing.

b. Synthetic Detergent (ABS). All samples collected for ABS determinations were below determinable levels (i.e., <0.1 mg/l).

c. Chloride. Chloride samples collected from Bijou Creek at stations along the golf course were 1.0 mg/l. The chloride rose to 3.5 mg/l at the mouth of the creek at Station 1-B. During Phase I, the flow at the mouth of Bijou Creek was yellowish and this color was evident in Lake Tahoe several hundred yards offshore.

d. Phosphate and Plankton. A phosphate sample collected from Station 2-B near the Bijou Shopping Center was 1.52 mg/l during the early summer period. Plankton at this station in the same period was 980 per ml. Plankton density at the mouth of Bijou Creek was 51 per ml during the late summer, and the prominent specie was Euglena.

The sampling notes report that Bijou Creek was "unsightly and foul smelling" and that oil or gasoline films were evident in the vicinity of the shopping center. At one place, evidence showed that a service station was discharging oily wastes into the creek. At least one dead fish was found. Accumulations of trash were heavy along the stream banks in this area.

## B. LOWER TRUCKEE RIVER SAMPLING PROGRAM

### 1. Introduction

The chart in Figure 15, which follows, shows the locations of sampling stations along the Lower Truckee River. For convenience, the station designations follow closely those that had been established in earlier routine studies on this stream. The stations progress downstream from the outlet dam at Lake Tahoe (Station 1-T) to a station at Farad (Station 11-T). Sampling stations in Squaw Valley have the letter "S" affixed to the station number.

Table XVI summarized the data obtained in the sampling of this river, while Table XVII shows the results of sampling in the Squaw Valley area. Table XVIII lists the stream and spring sources in the Donner-Truckee region during the early summer sampling period. Contingencies prevented repeat sampling during the late summer phase in this area.

### 2. Discussion of Results

a. Coliform Bacteria and Turbidity. Coliform samples collected during Phase I at the head of the Lower Truckee River in Tahoe

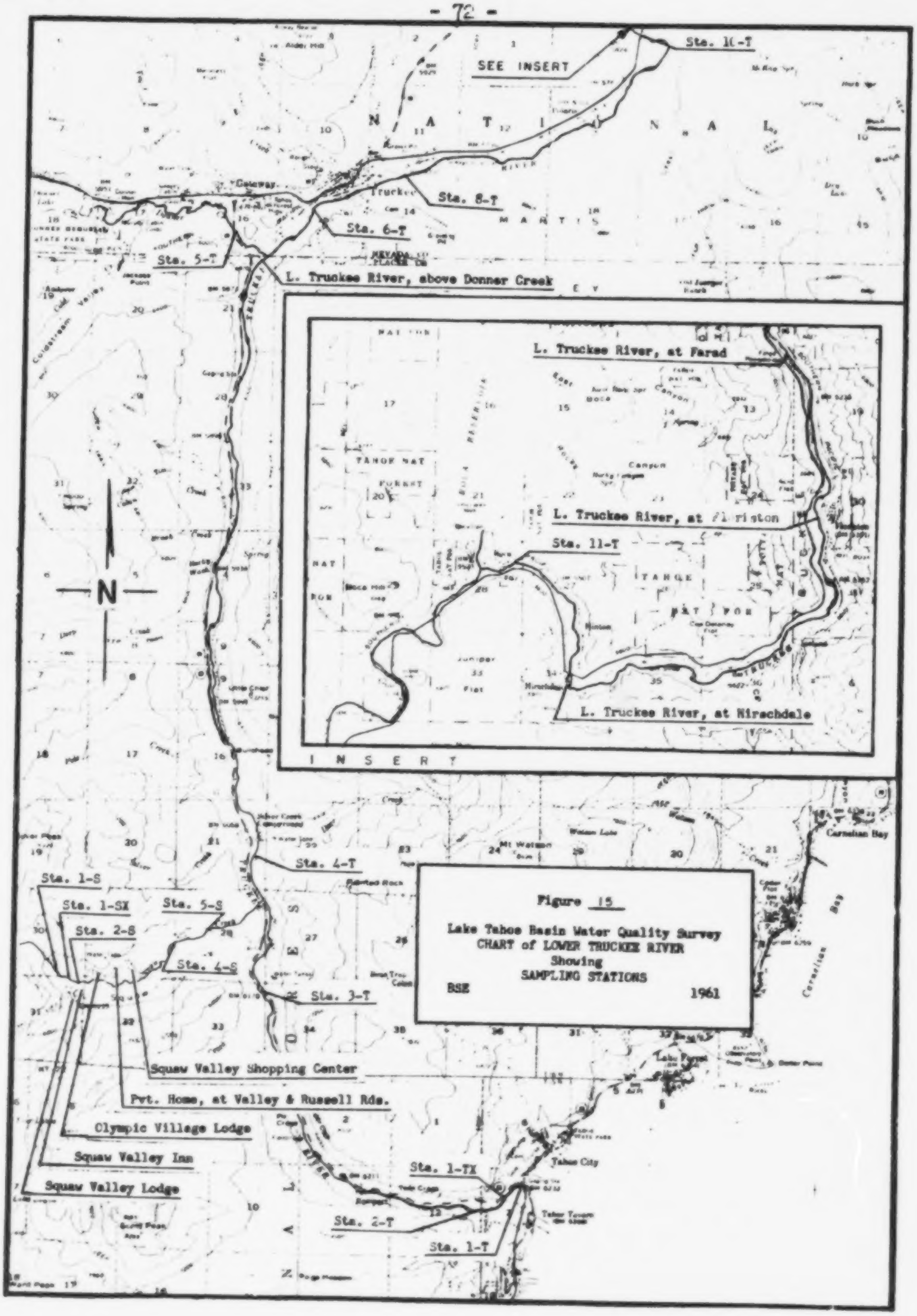
SEE INSERT
Sta. 10-T
N A T I O N A L
Sta. 8-T
Truckee
Gateway
Sta. 6-T
Sta. 5-T
M A R T I S
L. Truckee River, above Donner Creek
N
L. Truckee River, at Farad
L. Truckee River, at Floriston
Sta. 11-T
TAHOE NAT FOREST
TAHOE NAT FOR
Juniper Flat
Hirschdale
L. Truckee River, at Hirschdale
I N S E R T
Sta. 4-T
Sta. 1-S
Sta. 1-SX
Sta. 5-S
Sta. 2-S
Sta. 4-S
Sta. 3-T
Carnelian Bay
Lake Forest
Squaw Valley Shopping Center
Pvt. Home, at Valley & Russell Rds.
Olympic Village Lodge
Squaw Valley Inn
Squaw Valley Lodge
Sta. 1-TX
Tahoe City
Sta. 2-T
Sta. 1-T

Figure 15

Lake Tahoe Basin Water Quality Survey
CHART of LOWER TRUCKEE RIVER
Showing
SAMPLING STATIONS

BSE 1961

## SPECIFIC STATION DESCRIPTIONS

## LOWER TRUCKEE RIVER SAMPLING PROGRAM

| | |
|---|---|
| 1-T | Lower Truckee River at Highway 89 bridge in Tahoe City (outlet of Lake Tahoe) |
| 1-TX | Lower Truckee River opposite Tahoe City Public Utility District Sewage Treatment Plant |
| 2-T | Lower Truckee River at first bridge past highway maintenance shops (one-fourth mile below sewage treatment plant) |
| 3-T | Lower Truckee River at Highway 89 bridge, which spans the Lower Truckee River (just below Squaw Valley) |
| 4-T | Lower Truckee River at first private road (one-half mile below Squaw Creek turnoff - Steffen Res.) |
| 1-S | Branch of Squaw Creek above last development (above sewage treatment plant) |
| 2-S | Branch of Squaw Creek approximately 200 yards below sewage treatment plant |
| 4-S | Squaw Creek below Poulsen development |
| | Samples from water systems of the three lodges:<br>Squaw Valley Lodge<br>Squaw Valley Inn<br>Olympic Village |
| 5-T | Donner Creek at junction with Highway 89 (one-half mile before junction with Highway 40) |
| 6-T | Lower Truckee River above City of Truckee |
| 8-T | Lower Truckee River below City of Truckee |
| 10-T | Lower Truckee River below Truckee Public Utility District Sewage Treatment Plant |
| 11-T | California Department of Water Resources Sampling Station (Town of Boca) |

## TABLE XVI

### LOWER TRUCKEE RIVER SAMPLING DATA

| STATION AND DESCRIPTION | PHASE I (JULY 3, 5) | | | PHASE II (SEPTEMBER 4) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | Cl- (mg/1) | $PO_4$ (mg/1) | Plankton & Algae (per ml) |
| 1-T Lower Truckee River at Lake Tahoe Outlet[a] | 15<br>5 | <0.1<br><0.1 | <0.5<br>0.5 | 620 | <0.1 | 0.3 | 1.1 | <.01 | 270 |
| 1-Tx Lower Truckee River, opposite Tahoe City STP | 38<br>15 | <0.1<br><0.1 | <0.5<br>0.5 | 230 | <0.1 | 0.2 | 1.0 | | |
| 2-T Lower Truckee River, below STP | 38<br>15 | <0.1<br><0.1 | 0.5<br><0.5 | 230 | <0.1 | 0.3 | 1.1 | | |
| 3-T Lower Truckee River, above Squaw Creek[b] | >240<br>- | <0.1<br><0.1 | 1.0<br>1.0 | 230 | <0.1 | - | 1.7 | | |
| 1-S Squaw Creek, above Olympic STP | 240<br>240 | <0.1<br><0.1 | 1.0<br>0.5 | | | | | | |
| 1-Sx Squaw Creek, 400' below Olympic STP[c] | - | - | 81 | | | | | | |
| 2-S Squaw Creek, 600' below Olympic STP[d] | >240<br>240 | <0.1<br><0.1 | 1.5<br><0.5 | 230 | <0.1 | 3.1 | 12.4 | | |

[a] Two culvert drains discharging below bridge.
[b] Area littered with cans and papers.
[c] Water brown. Bulldozing and loading gravel from the creek.
[d] Storm drains below station.

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XVI (continued)

| STATION AND DESCRIPTION | PHASE I (JULY 3, 5, 6) | | | PHASE II (SEPTEMBER 4) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | Cl- (mg/1) | PO4 (mg/1) | Plankton & Algae (per ml) |
| 4-S Squaw Creek, below[e] Poulsen STP | >240<br>240 | <0.1<br><0.1 | 1.0<br>1.0 | | | | | | |
| 5-S Squaw Creek, at bridge[f] below STP | | | | 620 | <0.1 | - | 4.4 | | |
| 4-T Lower Truckee River, below Squaw Creek | >240<br>240 | <0.1<br><0.1 | 0.7<br><0.5 | 62 | <0.1 | - | 1.6 | <.01 | 410 |
| 5-T Donner Creek, at Hwy.89[g] | >240<br>>240 | <0.1<br><0.1 | 0.5<br><0.5 | 62 | <0.1 | 0.5 | 2.4 | | |
| 6-T Truckee River, above[h] Truckee | >240<br>240<br>240<br>240 | <0.1<br><0.1<br>- | 1.0<br><0.5<br>- | 230 | <0.1 | 0.8 | 2.0 | | |
| 8-T Truckee River, at dump[i] below Truckee | >240<br>38<br>38<br>38 | <0.1<br><0.1<br>- | 1.0<br>1.0<br>- | 620 | <0.1 | 0.5 | 2.5 | | |

e Cattle and horses at creek.
f Scum along shoreline.
g Culverts discharge below station.
h Phase I - Smoky gray water, no activity.
i Phase I - Water gray, no activity.

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XVI (continued)

| STATION AND DESCRIPTION | PHASE I (JULY 3, 5, 6) | | | PHASE II (SEPTEMBER 4) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100 ml) | ABS (mg/l) | Turb. (T.U.) | Coliform (MPN/100 ml) | ABS (mg/l) | Turb. (T.U.) | Cl⁻ (mg/l) | $PO_4$ (mg/l) | Plankton & Algae (per ml) |
| 10-T Lower Truckee River, below Truckee STP, at U.S. Highway 40 | >240<br>240<br>240<br>>240 | 0.1<br><0.1<br>- | 0.5<br>0.5<br>- | 23 | <0.1 | 0.3 | 2.0 | .04 | 1300 |
| 11-T Lower Truckee River, at Boca | 240<br>38 | - | - | 6 | <0.1 | 0.3 | 2.0 | | |
| Lower Truckee River, at Hirschdale | 240 | - | - | | | | | | |
| Lower Truckee River, at Florston | 240<br>38 | - | - | | | | | | |
| Lower Truckee River, above Donner Creek | >240<br>38 | - | - | | | | | | |
| Lower Truckee River, at Farad | 240<br>240 | - | - | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

TABLE XVIT

**Sector** SQUAW VALLEY (SAMPLING DATA)

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL⁻ (mg/1) | NO3⁻ (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL⁻ (mg/1) | NO3⁻ (mg/1) | PO4 (mg/1) |
| **WELLS** | | | | | | | | | | | | |
| Olympic System | <2, <2 | <0.1 | | | | | <4.5 | <0.1 | | 12.1 | | |
| | <2, <2 | <0.1 | | | | | <4.5 | | | | | |
| | <2, <2 | <0.1 | | | | | | <0.1 | | 12.0 | | |
| Olympic Village | <2 | | | | | | <4.5 | | | | | |
| Squaw Valley Inn | <2 | | | | | | <4.5 | | | | | |
| Squaw Valley Lodge | 4.4 | | | | | | 21 | | | | | |
| **STREAM** | | | | | | | | | | | | |
| Squaw Creek | 4.4 | | | | | | 38 | <0.1 | | 0.4 | | |
| | | | | | | | | <0.1 | 0.0 | 15.4 | | |

## TABLE XVIII

### SAMPLE ANALYSES OF WELLS AND SPRINGS IN THE DONNER-TRUCKEE AREA

### LOWER TRUCKEE RIVER SAMPLING PROGRAM - PHASE I

| Place Sampled | Source | Date | Coliform (MPN/100 ml) | ABS (mg/l) | Turb. (T.U.) | $NO_3$ (mg/l) | Remarks |
|---|---|---|---|---|---|---|---|
| Walker House (center) | Spring | 7-5 | 5<br>8.8 | <0.1 | 0.5 | 0 | |
| Builders Service Center (NE) | ? | 7-5 | 2.2<br>2.2 | | | | |
| Donner Pines Motel (10 units) | Well | 7-5 | 2.2<br><2 | | | | |
| Donner Lake Summer Home Tract(25 homes) | Spring (unimproved) | 7-5 | <2<br>8.8 | | | | Animal and human hazard. |
| Lewis Well (Truckee P.U.D.) | Well | 7-5 | <2<br><2 | | | | |
| Donner Well, Checking Station | Well | 7-5 | 12<br>15 | <0.1 | 0.5 | 0.3 | |
| Shaffer Spring (Truckee P.U.D.) | Spring | 7-5 | 2.2<br><2 | | | | |
| Tolofson, Sr., Home | Well | 7-6 | 5<br>5 | | | | Shallow well next to river. |
| Frank Fox, Home | Well | 7-6 | <2<br><2 | | | | Shallow well next to river. |

(continued)

TABLE XVIII (continued)

| Place Sampled | Source | Date | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_3$ (mg/1) | Remarks |
|---|---|---|---|---|---|---|---|
| Rex Tolofson, Home | Well | 7-6 | 8.8<br>38 | | | | Shallow well next to river. |
| Van Sycle, Home | Well | 7-6 | 38<br>38 | | | | Horses pastured near shallow well. |
| Hellar's Trailer Park (26 trailers; 1 house) | Spring | 7-6 | 240<br>38 | | | | Three septic tanks. |
| Southside Well, Truckee P.U.D. | Well and Spring | 7-6 | <2<br>2.2 | | | | |
| McGlashen Spring | Spring | 7-6 | <2<br><2 | | | | |
| K.H.O.E., Truckee P.U.D. | ? | 7-6 | 2.2<br>5 | | | | |
| Water Tap, Flycasters' Club | Well | 7-6 | <2<br><2 | | | | Well 200 feet deep. |

(continued)

**Lake Tahoe Basin Water Quality Survey, 1961**

**TABLE XVIII** (continued)

| Place Sampled | Source | Date | Coliform (MPN/100 ml) | ABS (mg/1) | Turb. (T.U.) | $NO_3$ (mg/1) | Remarks |
|---|---|---|---|---|---|---|---|
| Recreation House, Boca | ? | 7-6 | 15<br>5 | | | | |
| Kirby-Hirschdale Restaurant(Old System) | Well | 7-6 | 38<br>15 | | | | |
| Kirby-Hirschdale Restaurant(New System) | Well | 7-6 | 240<br>>240 | | | | |
| Grag, Home | ? | 7-6 | 38<br>240 | | | | |
| Donner State Park (Campground) | Spring | 7-5 | 240<br>12 | | | | |
| Donner State Park | Well | 7-5 | <2<br><2 | | | | |

City showed results of 15 and 5 MPN per 100 ml. A very slight increase was measured a short distance downstream opposite the Tahoe City P.U.D. sewage treatment plant. Coliform values reached ranges of 240 or greater from a station above the confluence of Squaw Creek and remained in this range downstream past the town of Truckee to the last sampling station at Farad. Levels of coliform bacteria populations did not indicate that any significant amount of sewage wastes were entering the stream. Turbidity values were consistently low throughout the measured extent of the river. One high turbidity analysis showed in a sample collected in Squaw Creek about 400 feet below the Olympic sewage treatment plant. Road repair and maintenance projects were in progress at the time of sampling. The turbidity found at this station was not apparent several hundred yards downstream.

The corresponding Phase II sampling data showed similar orders of coliform bacteria populations, and turbidities again were quite low. Some slightly colored waters were observed at Stations 6-T and 8-T.

b. Synthetic Detergent (ABS). At all stations on the Lower Truckee River, ABS results were below laboratory determinable levels. This was true during both phases of study.

c. Chloride. Chloride levels were usually low throughout the river, and they ranged from 1.0 to 2.5 mg/l. Exceptions were found in Squaw Creek where the chlorides were 12.4 mg/l below the Olympic sewage treatment plant, and 4.4 mg/l at the Squaw Creek bridge crossing in the valley.

d. Phosphate and Plankton. Phosphate samples collected from the Truckee River were below determinable levels except for one value of 0.04 mg/l, which was found at Station 10-T. This station is on the Truckee River below the Truckee sewage treatment plant. Plankton densities were in relatively low orders; the highest (1300 per ml) was found at Station 10-T.

e. Donner-Truckee Sampling. The results obtained from the random sampling of wells, streams and springs throughout this area show no significant effects upon water quality by local sewage disposal practices.

## C. SECTOR STUDIES

### 1. Introduction

As was described earlier, the investigations of wells, springs and streams in areas adjacent to the shores of Lake Tahoe were divided arbitrarily into geographic zones or sectors for the convenience of tabulation of results. The division boundaries of these sectors is shown in the sketch in Figure 16. The sampling results obtained will be

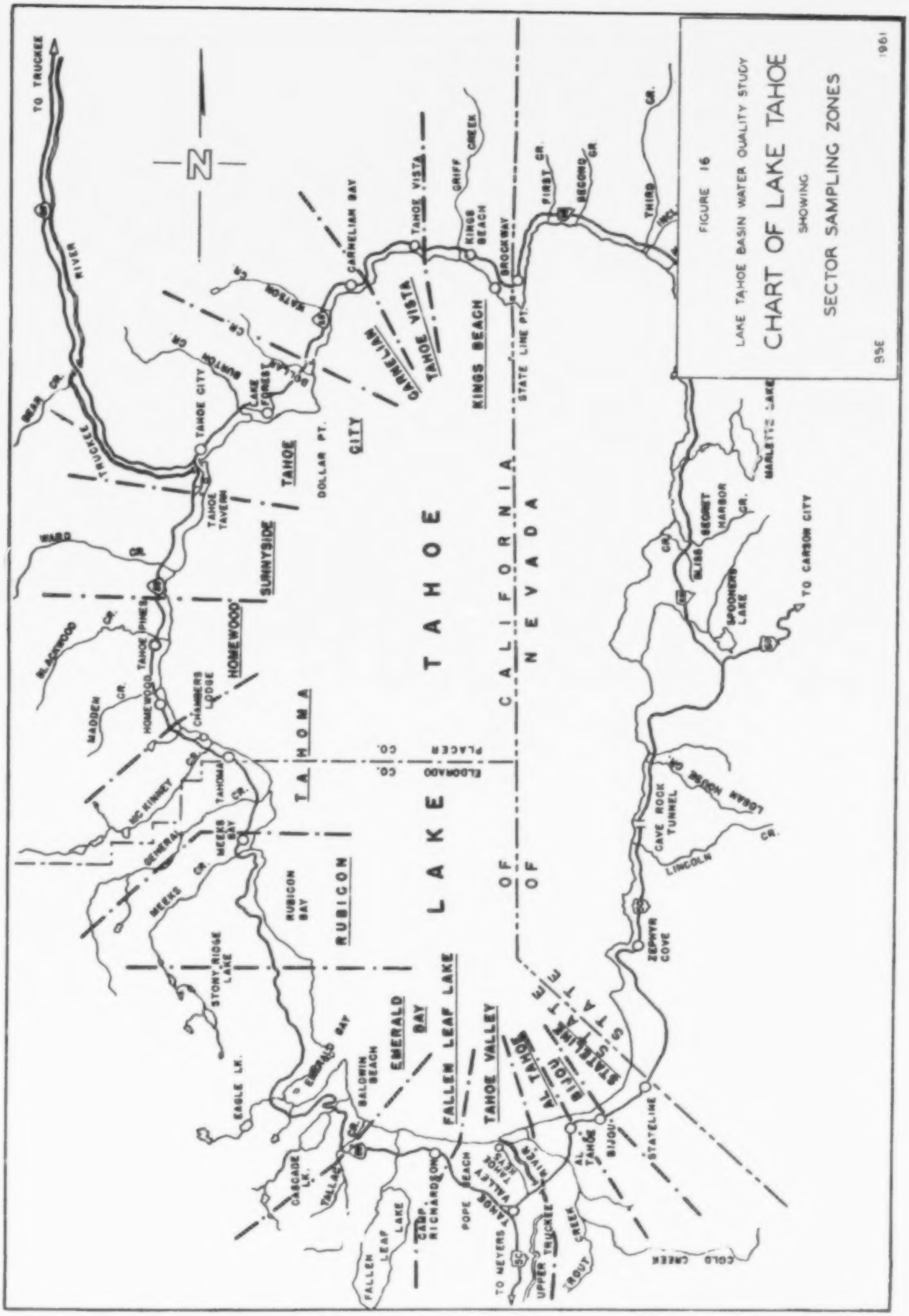
N
TO TRUCKEE
TRUCKEE RIVER
BEAR CR.
TAHOE CITY
BURTON CR.
DOLLAR CR.
LAKE FOREST
WATSON CR.
CARNELIAN BAY
TAHOE VISTA
GRIFF CREEK
KINGS BEACH
BROCKWAY
STATE LINE PT.
FIRST CR.
SECOND CR.
THIRD CR.
TAHOE CITY
CARNELIAN
TAHOE VISTA
KINGS BEACH
DOLLAR PT.
TAHOE
TAHOE TAVERN
WARD CR.
SUNNYSIDE
BLACKWOOD CR.
TAHOE PINES
HOMEWOOD
MADDEN CR.
CHAMBERS LODGE
TAHOMA
MC KINNEY CR.
GENERAL CR.
MEEKS BAY
MEEKS CR.
RUBICON BAY
RUBICON
STONY RIDGE LAKE
EAGLE LK.
EMERALD BAY
BALDWIN BEACH
CASCADE LK.
TALLAC CR.
FALLEN LEAF LAKE
CAMP RICHARDSON
POPE BEACH
TAHOE VALLEY
TAHOE KEYS
UPPER TRUCKEE RIVER
TO MEYERS
TROUT CREEK
AL TAHOE
BIJOU
STATELINE
COLD CREEK
LAKE TAHOE
STATE OF CALIFORNIA
STATE OF NEVADA
PLACER CO.
ELDORADO CO.
ZEPHYR COVE
CAVE ROCK TUNNEL
LINCOLN CR.
LOGAN HOUSE CR.
SPOONERS LAKE
TO CARSON CITY
SECRET HARBOR CR.
GLENBROOK
MARLETTE LAKE

FIGURE 16

LAKE TAHOE BASIN WATER QUALITY STUDY

CHART OF LAKE TAHOE

SHOWING

SECTOR SAMPLING ZONES

SSE

1961

## TABLE XIX

(15 data pages included in Table)

## SAMPLING RESULTS OF SECTOR STUDIES

Wells, Streams and Springs Sampling Program

Lake Tahoe Basin Water Quality Study, 1961

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector KINGS BEACH

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) |
| WELLS | | | | | | | | | | | | |
| STREAMS | 240, 240 | | 1.0 | | | | 620, 130 | 0.1 | | 0.0 | | |
| | 38, 240 | 0.1 | | | | | | | | | | |
| | 23 | <0.1 | | 1.8 | <0.5 | | | | | | | |
| SPRINGS | >240, 240 | | 0.0 | | | | 620, 230 | 0.1 | | 0.0 | | |
| | >240, >240 | 0.1 | 2.5 | | <0.5 | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector TAHOE VISTA

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) |
| WELLS | <2, <2 | | | | | | <4.5 | <0.1 | | | <0.5 | |
| | <2, <2 | <0.1 | | 0.8 | | | | | | | | |
| | <2, <2 | <0.1 | | 1.9 | | | | | | | | |
| STREAMS | | | | | | | | | | | | |
| SPRINGS | | | | | | | <4.5, <4.5 | <0.1 | | 0.0 | | |

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector CARNELIAN BAY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) |
| WELLS | | | | | | | | | | | | |
| STREAMS | <2, <2, <2 | | | | | | <4.5, 6 | <0.1 | | 1.0 | | |
| SPRINGS | <2, 2.2 | <0.1 | | | <0.5 | | <4.5, 6 | <0.1 | | 1.5 | | |

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector TAHOE CITY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) |
| WELLS | 2.2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| | <2, 5 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| | <2, <2, <2 | | | | | | | | | | | |
| | 2.2 | 0.1 | 0.5 | | <0.5 | | | | | | | |
| STREAMS | >240 | <0.1 | 1.5 | | <0.5 | | 240, >2400 | <0.1 | | 0.6 | | |
| | | | | | | | <4.5, 620 | <0.1 | | 0.0 | | |
| SPRINGS | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| | <2, 5 | <0.1 | | | <0.5 | | 6, 50 | <0.1 | 1.6 | 0.1 | | |
| | 8.8, 5 | <0.1 | 1.0 | | <0.5 | | | | | | | |
| | 15, 15 | <0.1 | 3.5 | | <0.5 | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector SUNNYSIDE

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) |
| WELLS | 2.2, 2.2 | <0.1 | | | 0.35 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 2.2, 2.2 | <0.1 | | | <0.5 | | 6, 23 | | | | | |
| | 15, 8.3 | | | | | | 6, 23 | | | | | |
| | <2, <2 | | | | | | <4.5, <4.5 | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | <2, <2 | <0.1 | | | 1.56 | | <4.5, <4.5 | <0.1 | | 0.4 | | |
| | <2, <2, <2, 38, 38 | <0.1 | | | <0.5 | | | | | | | |
| STREAMS | 15, 38 | <0.1 | <0.5 | | <0.5 | | 230, 620 | <0.1 | | 0.0 | | |
| | 38, 38 | <0.1 | 0.5 | | <0.5 | | 62, 500 | | | | | |
| | | | | | | | 62, 620 | <0.1 | | 0.6 | | |
| | | | | | | | 230 | <0.1 | 0.7 | 0.0 | | |
| | | | | | | | 620 | <0.1 | 0.2 | 0.6 | | |
| | | | | | | | 23 | 0.1 | 1.1 | 0.2 | | |
| SPRINGS | <2, <2 | | | | | | 62, 620 | <0.1 | | 0.5 | | |
| | <2, <2 | | | | | | 6, <4.5 | | | | | |
| | 2.2, 2.2 | <0.1 | | | <0.5 | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector HOMEWOOD

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) |
| WELLS | <2, <2 | | | | | | | | | | | |
| | <2, 5 | | | | | | | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | | | | | | |
| STREAMS (Blackwood Creek) | | | | | | | 230 | <0.1 | 0.3 | 0.0 | | |
| | | | | | | | 1300 | <0.1 | 1.0 | 0.0 | | |
| | | | | | | | 38, 23 | 0.1 | 1.4 | 0.0 | | |
| SPRINGS | 38, 240 | <0.1 | | | <0.5 | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector TAHOMA

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) |
| WELLS | <2 | <0.1 | | | <0.5 | | <4.5, 6 | <0.1 | | 2.0 | <0.5 | |
| | <2 | <0.1 | | | 1.0 | | >24,000 | <0.1 | | 1.5 | 0.4 | |
| | <2, <2 | | | | | | 2300 | | | | | |
| | 2.2 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| STREAMS | >240, >240 | <0.1 | | | | | 62, 230 | 0.1 | | 1.0 | <0.5 | |
| | 240 | <0.1 | | | <0.5 | 0.05 | 62, 230 | 0.1 | | 0.0 | <0.5 | |
| | | | | | | | 620, 1300 | 0.1 | | 0.2 | | |
| SPRINGS | | | | | | | | | | | | |

2811

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector RUBICON BAY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) |
| WELLS | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 5, 12 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | | | | | | | 620, 620 | <0.1 | | 1.0 | <0.5 | |
| STREAMS | 240, 240 | | | | | | 7,000 | <0.1 | 0.9 | 1.0 | | |
| | 20, 240 | <0.1 | 3.5 | | | | | | | | | |
| | 15, 15 | <0.1 | 5.0 | | <0.5 | 0.02 | | | | | | |
| | 15, 38 | | | | | | | | | | | |
| | 15, 38 | | | | | | | | | | | |
| | 240 | <0.1 | | | <0.5 | <0.02 | | | | | | |
| SPRINGS | 21, 240 | <0.1 | | | <0.5 | | | | | | | |
| | >240, 240 | | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector EMERALD BAY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | NO3 (mg/l) | PO4 (mg/l) |
| WELLS | | | | | | | | | | | | |
| STREAMS | 2.2, 5.0 | <0.1 | | | <0.5 | | 230, 230 | <0.1 | | 1.0 | | |
| | 12, 15 | <0.1 | | | <0.5 | | 230, 2300 | <0.1 | | 1.0 | | |
| | 38, 38 | <0.1 | | | <0.5 | 0.27 | 230 | <0.1 | 0.3 | 2.0 | | |
| | | | | | | | 62, 23 | | | | | |
| | Total Plankton 240/100 ml at Cascade Creek | | | | | 6/22 | 620 | <0.1 | 0.3 | 3.0 | | |
| SPRINGS | 15, 240 | <0.1 | | | <0.5 | | 230, 620 | <0.1 | | 1.0 | | |
| | 38, 240 | <0.1 | | | <0.5 | | 6, 6 | <0.1 | | 1.0 | | |
| | 12, 8.8 | <0.1 | | | <0.5 | | | | | | | |
| | 240, >240 | | | | | | | | | | | |

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector FALLEN LEAF LAKE

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) |
| WELLS | | | | | | | <4.5, 6 | <0.1 | | 2.0 | <0.5 | |
| STREAMS | 240, 240 | <0.1 | | | <0.5 | | 23, 62 | <0.1 | | 1.0 | | |
| | 38, 240 | <0.1 | | | <0.5 | 0.05 | 2300, 62 | <0.1 | | 2.0 | | |
| | 15, 38 | <0.1 | | | <0.5 | | 230, 230 | <0.1 | | 1.0 | | |
| | 38, 240 | <0.1 | | | <0.5 | | | | | | | |
| | 15, 8.8 | <0.1 | 0.5 | | | 0.23 | 620 | <0.1 | 0.5 | 1.0 | | |
| | Total Plankton 100/100 ml at Tallac Creek 6/22<br>Total Plankton 260/100 ml at Taylor Creek 6/22 | | | | | | | | | | | |
| SPRINGS | 38, 240 | <0.1 | | | <0.5 | | 4.6, 12 | | | | | |
| | <2, 2.2 | | | | | | <4.5, <4.5 | | | | | |
| | 15, 38 | <0.1 | | | <0.5 | | <4.5, 4.6 | | | | | |
| | 4.4, 5 | <0.1 | | | <0.5 | | | | | | | |
| | 240, 240 | <0.1 | | | <0.5 | | | | | | | |

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector TAHOE VALLEY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) |
| WELLS | 8.8, 5.0 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| | 15, 15 | | | | | | <4.5, <4.5 | <0.1 | | 2.0 | | |
| | 2.2, <2 | | | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 2.2, <2 | <0.1 | | | 1.5 | | <4.5, <4.5 | <0.1 | | 1.5 | | |
| | <2, <2 | <0.1 | | | 0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | <2, 2.2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 2.0 | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.5 | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 2.0 | | |
| | <2, 8.8 | | | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 2.2, 2.2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 2.0 | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 2.0 | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 5, 8.8 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2, 15 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2, 2.2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2, 5 | <0.1 | 6.2 | | <0.5 | | | | | | | |

(continued)

## LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector TAHOE VALLEY

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | Coliform (MPN/100ml) | ABS (mg/l) | TURB. (T.U.) | CL (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) |
| WELLS | <2, <2, <2 | <0.1 | 8 | | | | | | | | | |
| | <2, 2.2 | <0.1 | 6.2 | | <0.5 | | | | | | | |
| | 2.2, 2.2 | <0.1 | 3.0 | | <0.5 | | | | | | | |
| | 8.8, 15 | <0.1 | | | <0.5 | | | | | | | |
| | 5, 2.2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2 | <0.1 | 3.0 | | <0.5 | | | | | | | |
| | 5, 15 | <0.1 | | | <0.5 | | | | | | | |
| SPRINGS | 240,240 | <0.1 | 8.0 | | <0.5 | | | | | | | |
| | 240, 96 | <0.1 | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector AL TAHOE

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) |
| WELLS | <2, 21 | <0.1 | | | <0.5 | | <4.5, <4.5 | 0.12 | | 9.0 | 11.0 | |
| | <2, 5 | 0.3 | | | 5.0 | | <4.5, <4.5 | <0.1 | | 2.0 | 1.4 | |
| | <2, 5 | <0.1 | | | 1.0 | | <4.5, <4.5 | <0.1 | | 3.0 | | |
| | <2, <2 | | | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | <2, <2 | <0.1 | | | 1.0 | | <4.5, <4.5 | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | | | | | | |
| | <2 | <0.1 | | | <0.5 | | | | | | | |
| STREAMS | | | | | | | 23 | <0.1 | | 1.0 | | |
| | 240, 15 | <0.1 | | | <0.5 | | 62, 62 | <0.1 | | 1.0 | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector BIJOU

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) |
| WELLS | <2, <2 | <0.1 | | | <0.5 | | <4.5, <4.5 | | | | | |
| | <2, <2 | | | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 5, 8.8 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 4.4, 8.8 | | | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | <2, <2 | | | | | | | | | | | |
| | <2, 2.2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, 2.2 | | | | | | | | | | | |
| | <2, <2 | | | | | | | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, 2.2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | | | | | | |
| | <2, <2 | <0.1 | | | <0.5 | | | | | | | |
| | 2.2, 5 | <0.1 | | | <0.5 | | | | | | | |
| | <2, 15 | <0.1 | | | <0.5 | | | | | | | |
| STREAMS | >240,>240 | <0.1 | 9.5 | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY, 1961 - WELLS, STREAMS, SPRINGS

Sector STATELINE

| SOURCE | PHASE I (Early Summer) | | | | | | PHASE II (Late Summer) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) | Coliform (MPN/100ml) | ABS (mg/1) | TURB. (T.U.) | CL (mg/1) | NO3 (mg/1) | PO4 (mg/1) |
| WELLS | 2.2, 5.0 | <0.1 | | | <0.5 | | 95, 230 | <0.1 | 0.5 | 1.0 | | |
| | <2, 5.0 | | | | | | <4.5, <4.5 | <0.1 | 0.6 | 1.0 | | |
| | <2, 6.8 | <0.1 | | | <0.5 | | <4.5, <4.5 | <0.1 | 0.6 | 1.0 | | |
| | <2, 2.2 | <0.1 | 2.5 | | | | <4.5, <4.5 | <0.1 | | 1.0 | | |
| | 2.2, 240 | | | | | | <4.5 | <0.1 | | 1.0 | | |
| | <2, 2.2 | | | | | | 240, 700 | | | | | |
| | <2, <2 | <0.1 | 29 | | <0.5 | | 240, 23 | | | | | |
| | <2, <2 | <0.1 | 9.5 | | <0.5 | | | | | | | |
| | <2, <2 | <0.1 | <0.1 | | | | | | | | | |
| | <2, <2 | | | | | | | | | | | |

discussed progressively by sector. A summary of the sampling data appears in Table XIX. Specific descriptions of sampling stations are not made since the study was concerned with a representative appraisal of the general water quality conditions in the area. At the time of the sector investigations, routine searches were made for failing sewage disposal systems, especially of the individual type using soil absorption methods. A discussion of these findings appears later in the report under the chapter "Assessment of Sewage Disposal Practices."

2. Discussion of Results

a. Kings Beach. Coliform levels of samples collected from streams and springs in the area were considerably higher than those recommended for drinking water standards. Tests for ABS (synthetic detergent), chloride, and nitrate were in low orders of magnitude, indicating that it was unlikely that these waters were being affected by sewage disposal practices.

b. Tahoe Vista. Sampling investigations showed no adverse effects of sewage disposal practices on water quality in this sector. Persons in the area remarked about cases in which individual sewage systems had failed in past seasons. They cited incidents when sewage pumping stations had overflowed in the past, causing nuisance odors. No evidences of failing sewage disposal systems were found during the time of this survey, however.

c. Carnelian Bay. Sampling results show that sewage disposal practices have no adverse effect on the quality of water supplies within this sector.

d. Tahoe City. The bacteriological quality of water supplies from wells and springs in the sector was quite good. All other analyses made as indices of sewage pollution were negative.

e. Sunnyside. A great number of individual wells were sampled, and bacteriological results compared favorably with drinking water standards. Although coliform levels were higher for stream samples, there appeared to be no indication of degradation by sewage disposal practices. Tests were essentially negative for ABS and chloride.

f. Homewood. The results of analyses from samples collected from wells, springs and streams in the sector do not show indications of adverse effect by sewage disposal practices.

g. Tahoma. Although the bacteriological quality of well waters sampled in the sector was generally good, two samples showed values of 2300 and >24,000 MPN per 100 ml. These values indicate that a follow-up sanitary inspection should be made. The coliform bacteria levels in streams were somewhat high (>240 to 1300 MPN per 100 ml). Several "positive" indications of ABS were found in samples collected in Blackwood Creek. However, these were only 0.1 mg/l.

h. Rubicon Bay. All findings of chemical and bacteriological analyses were satisfactory in this sector. There was no indication that sewage disposal practices were influencing the quality of the waters sampled.

i. Emerald Bay. Several springs and streams were sampled in this area and results show that coliform bacteria levels were generally higher than those limits recommended for drinking water standards. No values were in ranges high enough to suggest effects of sewage pollution, however. All tests for ABS were negative (i.e., below laboratory determinable levels). The total plankton measured at Cascade Creek was 240 per 100 ml.

j. Fallen Leaf Lake. Bacteriological results of samples collected from springs and streams in the sector were again higher than the limits recommended for drinking water standards. Tests for ABS and for other indices of sewage pollution were negative, however. Total plankton densities were quite low in streams sampled within the sector.

k. Tahoe Valley. Almost all individual and small water supply systems in the area obtain water from wells. A great number of samples were collected and the results show very satisfactory bacteriological qualities. All tests for ABS and other indices of sewage pollution were negative.

l. Al Tahoe. Many individual wells, and most of the large water supply wells in the sector were investigated and samples were collected. Bacteriological levels were very satisfactory. The results obtained from the sampling of one well showed a coliform MPN of 21 per 100 ml, a trace of ABS (0.3 and 0.12 mg/l), and a chloride analysis of 9.0 mg/l. Original notes describe the existence of an abandoned laundry sump within rather close range of the well. The survey information tends to show that the sump is influencing the water quality of this well.

m. Bijou. The bacteriological and chemical results obtained from the sampling of wells in this sector were satisfactory, there being no evidence of sewage pollution effects. Two coliform samples collected from Bijou Creek were both reported as greater than 240 MPN per 100 ml. The stream was negative for ABS.

n. Stateline. Only wells were sampled in this sector since there were no surface supplies. Bacteriological results in general were quite good, with some exceptions. A few samples showed results in the order of 240 and 700 MPN per 100 ml. All tests for ABS were negative. It is noteworthy that two samples showed turbidity values of 9.5 and 29 mg/l.

## III. ASSESSMENT OF SEWAGE DISPOSAL PRACTICES

Particular attention was given to the study of community sewage disposal systems in the Lake Tahoe Basin for the purpose of determining to what degree the effluents were affecting surface and ground waters. In this study, no attempt was made to appraise unit efficiencies or loadings of sewage treatment works. Chemical and bacteriological samples were collected from plant effluents and from appropriate surface and underground waters in downstream areas. Attention was given to the study of sewage pumping stations and collection systems which have been known to fail on occasion in the past.

With the help of the local health departments, sanitary survey investigations were also conducted at individual-type sewage disposal systems at private dwellings, motels, resorts, and summer camps. Samples were collected from nearby water supplies to find if water quality was being affected.

During the course of this study, several complaints were heard of actual or alleged sewage disposal failures. These were investigated immediately with joint cooperation of the appropriate local health department.

The local practices of commercial septic pumping were also investigated. Of special interest were the modes of operation and the places of disposal of the sludges collected by the tank truck units. Again, the local health departments provided supporting information, together with joint field investigations. The possibility that local industrial waste discharges might be affecting water quality was investigated to some degree.

Table XXVII is a summary of the field inspection log of observations and sampling data in the study of sewage disposal practices. The observations and comments are listed according to sector zones around Lake Tahoe and other Basin areas. See Figure 16 for sector identifications.

### A. COMMUNITY SYSTEMS

### 1. Discussion of Results

At the time of the investigations at the community sewage treatment plants in the Tahoe Basin, it was found that none of the sewage disposal practices were causing appreciable water quality effects in surface or underground supplies in their vicinities. A possible exception was that of the seepage from the South Tahoe P.U.D. sewage treatment plant which resulted in chemical and bacteriological changes in Heavenly Valley and Trout Creeks.

Analyses of samples collected from the seepage flows at the South Tahoe P.U.D. treatment plant showed significant coliform bacteria concentrations. Tests for synthetic detergents (ABS) showed presence at levels from 0.56 to 5.0 mg/l. The highest chloride concentration measure of the seepage was 44.5 mg/l. Further tests were made at progressive distances downstream. A short distance below the plant property, Heavenly Valley Creek joins Trout Creek, and the dilution afforded here reduced ABS to about 1.0 mg/l and chlorides were 21 mg/l. The upstream measure of chloride on Heavenly Valley Creek was 1.0 mg/l above the plant. About a mile downstream on Trout Creek, the effect of the seepage flows was further diminished. ABS was below determinable levels and chloride was only 1.5 mg/l. The level of bacteria fell to within a range where normal animal contamination could be suspected. Private wells in this area were studied and sample analyses showed no indication of sewage pollution.

All seven of the community sewage disposal systems in the Tahoe Basin discharge sewage effluents to land disposal by means of subsoil percolation, ponding of effluents or by final spray irrigation. Several of the plants provide secondary treatment.

Listed below are brief descriptions of these plants with summaries of the results of analyses from samples which were collected in appropriate circumstances.

a. Truckee Sanitary District. Sewage flows by gravity to the sewage treatment plant, which is below the town of Truckee on the south bank of the Truckee River. Treatment is by Imhoff tank and effluent is discharged to a series of shallow percolation ponds. Records show that the ponds have overflowed into the Truckee River on occasion in the past.

A few samples were collected from the influent and effluent flows at this plant. The results are shown below. Both coliform and fecal coliform analyses were made.

TABLE XX

SAMPLING RESULTS
TRUCKEE SANITARY DISTRICT
SEWAGE TREATMENT PLANT

DATE COLLECTED: SEPTEMBER 8, 1961

| PLACE SAMPLED | COLIFORM<br>FECAL COLIFORM (MPN/100 ml) | ABS (mg/l) | TURBIDITY (T.U.) | $Cl^-$ (mg/l) | $NO_3$ (mg/l) |
|---|---|---|---|---|---|
| Influent | ≥24,000,000<br>2,400,000 | | | | |
| Effluent (two samples) | ≥24,000,000<br>7,000,000 | | | | |
| | ≥24,000,000<br>7,000,000 | 20 | 17 | 22 | <0.5 |

b. Squaw Valley Olympic System. Sewage from State park facilities in the valley flows to a central pump station located near the Park Administration Building. From there, sewage is pumped to the sewage treatment plant. Secondary treatment is provided in a housed structure, and chlorinated effluent is discharged to a subsurface percolation bed which is situated about 100 feet from the channel of Squaw Creek.

Bacteriological samples were collected and analyzed for both coliform and fecal coliform organisms in the influent and effluent. Samples were also collected from Olympic system wells and in Squaw Creek. A summary of the data is given in Table XXI.

The results show that the quality of surface and well waters in Squaw Valley is not appreciably affected by sewage disposal practices in the immediate area.

c. Squaw Valley - Poulsen's System. This system presently serves a restaurant, a bar, and a number of shops and stores on privately owned land in Squaw Valley. Treatment is provided by aerobic digestion, and sewage effluent is pumped to subsurface percolation beds which are situated several hundred feet from Squaw Creek. Samples were not collected at this plant for bacteriological or chemical analysis.

d. Tahoe City P.U.D. Sewage from neighborhoods in Tahoe City flows to two pump stations, where the flow is pumped from the main station to the treatment plant. Secondary treatment is provided by biofiltration, and chlorinated effluent is pumped to hillside spray irrigation in the summer months and to open percolation ditches during the winter. The plant is situated a short distance west of Tahoe City, in somewhat steep terrain.

The main sewage pumping station and the auxiliary pumping station for the lake intake domestic water supply are separated by a distance of only several yards.

Several samples were collected from the treatment units. Both coliform and fecal coliform bacteriological analyses were made.

Stream sampling surveys made along the Lower Truckee River in previous seasons have reported seepages of sewage products from the Tahoe City P.U.D. sewage treatment plant. These flows have been traced to the Truckee River on occasions. During this survey no such overflows or seepages were found.

A summary of the results of sampling at this plant follows in Table XXII.

## TABLE XXI

## SAMPLING RESULTS

## SQUAW VALLEY OLYMPIC SYSTEM SEWAGE TREATMENT PLANT

DATE COLLECTED: SEPTEMBER, 8, 1961

| PLACE SAMPLED | COLIFORM<br>FECAL COLIFORM<br>(MPN/100 ml) | ABS (mg/1) | TURBIDITY (T.U.) | Cl$^-$ (mg/1) | NO$_3$ (mg/1) |
|---|---|---|---|---|---|
| Influent #1 | ≥24,000,000<br>≥24,000,000 | 3.0 | 59 | 16 | <0.5 |
| Influent #2 | 7,000,000<br>2,400,000 | | | | |
| Settled Effluent #1 | 2,400,000<br>2,400,000 | | | | |
| Settled Effluent #2 | ≥24,000,000<br>950,000 | | | | |
| Biofilter Effluent #1 | 230,000<br>230,000 | | | | |
| Biofilter Effluent #2 | 62,000<br>23,000 | | | | |
| Final Effluent #1 | 23,000<br>6,200 | 1.0 | 1.1 | 56 | 4 |
| Final Effluent #2 | 62,000<br>62,000 | | | | |
| Squaw Creek, below plant, 100 yards | 230<br><4.5 | | | | |
| " | 230<br><4.5 | | | | |
| Well No. 1(a) Olympic System | <4.5, <4.5<br><4.5, <4.5 | | | | |
| Well No. 2(a) Olympic System | <4.5, <4.5<br><4.5, <4.5 | <0.1 | 0.2 | 0.6 | |

(a) Duplicate Samples

## TABLE XXII

SAMPLING RESULTS

TAHOE CITY P.U.D.
SEWAGE TREATMENT PLANT

DATE COLLECTED: SEPTEMBER 8, 1961

| PLACE SAMPLED | COLIFORM<br>FECAL COLIFORM (MPN/100 ml) | ABS (mg/l) | TURBIDITY (T.U.) | Cl$^-$ (mg/l) | NO$_3$ (mg/l) |
|---|---|---|---|---|---|
| Influent #1 | ≥24,000,000<br>2,400,000 | 5.0 | 51 | 12 | <0.5 |
| Influent #2 | ≥24,000,000<br>2,400,000 | | | | |
| Clarifier Effluent #1 | ≥24,000,000<br>>24,000,000 | | | | |
| Clarifier Effluent #2 | ≥24,000,000<br>7,000,000 | | | | |
| Biofilter Effluent #1 | 2,400,000<br>2,400,000 | 5.0 | 26 | 11 | <0.5 |
| Biofilter Effluent #2 | 7,000,000<br>7,000,000 | | | | |

e. North Tahoe P.U.D. Sewage is collected at a series of three pumping stations situated along Highway 89. Primary treatment is provided by plain sedimentation and separate sludge digestion. The effluent is pumped to one of five hillside percolation ditches. A standby chlorinator is used for odor control or for emergency chlorination of the effluent. Standby auxiliary power is provided at all pumping stations. The district has been experiencing problems of odor control. Motel owners in Tahoe Vista complained of these odors during the study. Later, it was found that an effluent pond had become septic.

In the past, raw sewage has overflowed from pumping stations at the North Tahoe P.U.D. sewerage system. There were incidents when the sewage drained into Lake Tahoe. Since that time, standby power has been provided at the pumping stations and no further overflows have been recorded. The studies made during this survey do not indicate that the sewage disposal practices of the North Tahoe P.U.D. are are affecting water quality in immediate neighborhoods.

## TABLE XXIII

SAMPLING RESULTS
NORTH TAHOE P.U.D.
SEWAGE TREATMENT PLANT

DATE COLLECTED: SEPTEMBER 8, 1961

| PLACE SAMPLED | COLIFORM<br>FECAL COLIFORM (MPN/100 ml) | ABS (mg/l) | TURBIDITY (T.U.) | $Cl^-$ (mg/l) | $NO_3$ (mg/l) |
|---|---|---|---|---|---|
| Influent #1 | ≥24,000,000<br>7,000,000 | 4.0 | 24 | 10.0 | <0.5 |
| Influent #2 | ≥24,000,000<br>7,000,000 | | | | |
| Primary Effluent #1 | ≥24,000,000<br>7,000,000 | 4.0 | 50 | 9.6 | <0.5 |
| Primary Effluent #2 | ≥24,000,000<br>2,400,000 | | | | |

f. South Tahoe P.U.D. The District provides sewage collection service in the communities of Stateline, Bijou, and Al Tahoe. An activated sludge-type treatment plant was completed in recent years, replacing an outdated septic tank system. The treatment facilities are situated in the foothills south of Al Tahoe, near the confluence of Heavenly Valley and Trout Creeks. Plant effluent is pumped to a recently completed 70-million gallon oxidation pond on leased U. S. Forest Service lands. Ponded effluent can be pumped to a series of spray irrigation fields in a nearby stand of timber.

Extremely high sewage flows during the 1961 Labor Day week end threatened an overflow of the oxidation pond. As an emergency measure, District personnel operated the spray irrigation pumps in an effort to lower the critical pond level. The spray irrigation manifolding had not been entirely completed, and a considerable amount of sewage effluent drained from the saturated forest floor into downstream meadows. Some of the flow reached Heavenly Valley Creek. At this time, all survey crews were deployed in the program of routine investigations in the North Lake Tahoe regions and no samples were collected at the south end at the time the overflow was reported to have occurred.

The summary tables which follow show the results of routine sampling at the sewage treatment plant. A number of monitoring wells are spaced along the downhill berm of the oxidation pond. The wells were developed in order to monitor the characteristics of percolated effluent.

Table XXIV is a summary of the chemical analyses of samples collected from three of the test wells. Tests for ABS, chloride, and nitrate were done at all eight of the monitoring wells as measurement indices of travel of underground sewage pollution. The results are shown in Table XXV.

Samples were collected from other appropriate areas in, and adjacent to, the plant property and the results of these analyses are shown in Table XXVI. Considerable amounts of seepage were draining from embankments along the southwest boundary of the treatment plant. The seepage was sampled regularly, as there was obvious suspicion that some sewage wastes might be contained in the flow.

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## TABLE XXIV

### CHEMICAL ANALYSES OF SAMPLES COLLECTED FROM OXIDATION POND MONITORING WELLS

SOUTH TAHOE P.U.D. SEWAGE TREATMENT PLANT
COLLECTED: JULY 26, 1961

| DETERMINATIONS (mg/l) | WELL NO. 1 | WELL NO. 2 | WELL NO. 3 |
|---|---|---|---|
| Total Solids | 879 | 22,830(a) | 610 |
| Hardness | 75.5 | 63.0 | 48.5 |
| $HCO_3^-$ | 76.4 | 45.6 | 49.8 |
| $CO_3^=$ | 0 | 0 | 0 |
| $OH^-$ | 0 | 0 | 0 |
| Total ALK | 76.4 | 45.6 | 49.8 |
| Ca | 22.6 | 18.5 | 13.6 |
| Mg | 4.6 | 4.1 | 3.5 |
| Fe (total) | 7.7 | 560 (a) | 3.0 |
| Mn | 0.3 | 0.9 | 0.5 |
| Na | 9.4 | 9.9 | 8.2 |
| K | 2.7 | 3.3 | 2.3 |
| $Cl^-$ | 6.2 | 6.4 | 3.4 |
| $SO_4^=$ | 11.2 | 30.1 | 17.1 |
| $F^-$ | 0.2 | 0.2 | 0.2 |
| $NO_3^-$ as N | 0.4 | 0.05 | 0.1 |
| pH | 7.9 | 7.8 | 7.5 |
| ABS | 0.39 | 1.1 | 0.5 |

(continued)

TABLE XXIV (continued)

CHEMICAL ANALYSES OF SAMPLES COLLECTED
FROM OXIDATION POND MONITORING WELLS

SOUTH TAHOE P.U.D. SEWAGE TREATMENT PLANT
COLLECTED: JULY 26, 1961

| DETERMINATIONS (mg/l) | WELL NO. 1 | WELL NO. 2 | WELL NO. 3 |
|---|---|---|---|
| Boron | 0.4 | 0.4 | 0.08 |
| Percent Sodium | 20.6 | 24.3 | 25.9 |
| Sp. Conductance | 212 | 212 | 191 |
| Non Carb Hardness | - | 17.4 | - |

(a) Sampling container probably scooped up silica and iron in well bottom sediments. A measurement of insolubles dissolved in HCL was 19,540 ppm.

## TABLE XXV

## ABS, CHLORIDE AND NITRATE SAMPLING DATA FROM OXIDATION POND MONITORING WELLS

SOUTH TAHOE P.U.D. SEWAGE TREATMENT PLANT

COLLECTED: AUGUST 30, 1961

| MONITORING WELL NUMBER | ABS (mg/l) | CHLORIDE (mg/l) | NITRATE (mg/l) |
|---|---|---|---|
| 1 | 0.18 | 3.0 | <0.5 |
| 2 | 0.54 | 2.0 | <0.5 |
| 3 | 0.32 | 2.0 | <0.5 |
| 4 | 0.54 | 2.0 | <0.5 |
| 5 | 0.65 | 2.0 | <0.5 |
| 6 | 0.63 | 2.0 | <0.5 |
| 7 | 0.65 | 2.0 | <0.5 |
| 8 | 0.72 | 1.5 | <0.5 |

## TABLE XXVI

## MISCELLANEOUS SAMPLING IN THE ENVIRONS OF THE SOUTH TAHOE P.U.D. SEWAGE TREATMENT PLANT

| PLACE SAMPLED | DATE | COLIFORM BACTERIA (MPN/100 ml) | ABS (mg/1) | CHLORIDE (mg/1) | NITRATE (mg/1) |
|---|---|---|---|---|---|
| Oxidation Pond | 8-22 | - | 4.0 | 46 | 6.0 |
| Johnson Ditch Below Spray Irrig. | 8-23 | - | <0.1 | 1.0 | <0.5 |
| Ponding on Black Bart Ave. | 8-22 | - | <0.1 | 1.0 | <0.5 |
| Embankment Seepage at Sludge Beds | 8-29 | 230, 230<br><4.5, <4.5<br>230 | 3.2<br>3.2<br>3.6 | 39<br>44.5<br>- | -<br>-<br>- |
| Culvert Flow 100 Ft. N. of S.T.P.U.D. Office | 8-30 | ≥24,000 | 5.0 | 43 | <0.5 |
| Drain Pipe Flow 50 Ft. W. of S.T.P.U.D. Office | 8-30 | 62 | 0.57 | 40 | 1.2 |
| Combined Drainage Flow, 50 Ft. Below Culvert | 8-30 | 7,000 | 0.56 | 32 | 1.1 |
| Heavenly Valley Creek at Pioneer Trail | 6-27 | >240<br>240 | <0.1 | | <0.5 |
| | 8-29 | 62<br>230 | <0.1 | 1.0 | |

(continued)

Lake Tahoe Basin Water Quality Survey, 1961

TABLE XXVI (continued)

### MISCELLANEOUS SAMPLING IN THE ENVIRONS OF THE SOUTH TAHOE P.U.D. SEWAGE TREATMENT PLANT

| PLACE SAMPLED | DATE | COLIFORM BACTERIA (MPN/100 ml) | ABS (mg/l) | CHLORIDE (mg/l) | NITRATE (mg/l) |
|---|---|---|---|---|---|
| Confluence Heavenly Valley and Trout Creeks | 6-27 | >240 | <0.1 | | |
| | | >240 | <0.1 | | |
| | 8-29 | >2,400 | | | |
| | | >2,400 | 1.0 | 21.0 | |
| Trout Creek Station UT-13 | 6-27 | 240 | <0.1 | | <0.5 |
| | 8-29 | >2,400 | <0.1 | 1.5 | |
| | | 2,400 | <0.1 | 1.5 | <0.5 |
| | | 2,400 | | | |

For additional data, see analyses of samples collected on this watershed. See special report section, "Upper Truckee River Sampling Program".

## B. INDIVIDUAL SYSTEMS

The studies made of individual sewage disposal practices included those facilities at private homes and cabins, and at motels and resorts. This work was accomplished by making roving patrols in unsewered areas in each sector within the Basin. Greater attention was given to investigations in neighborhoods which have had histories of septic tank and leaching system failures. The local health departments were of great assistance in helping to direct this program of study.

It is important to comment that, in the course of this study, a number of persons described incidents in which neighboring sewage disposal systems had failed during a previous season. Because of the very dry conditions in Tahoe during this year of study, most of the systems were operating satisfactorily. If this study had been conducted following a spring of average or heavy runoff, many more failing systems might have been located.

A summary of individual sewage disposal observations, along with discussions of results, is grouped into sector neighborhoods according to the chart shown in Figure 16. Although some failing individual systems were found, none were overflowing into the lakes or surface waters.

## TABLE XXVII

### SUMMARY OF INDIVIDUAL SEWAGE DISPOSAL PRACTICES

### REPORTED BY SECTOR ARRANGEMENT

| SECTOR | OBSERVATIONS AND SAMPLING DATA |
|---|---|
| Kings Beach | One overflowing septic tank observed. Samples were collected from the pool of effluent.<br>Results<br>Coliform MPN/100 ml 62,000<br>Fecal Coliform MPN/100 ml 62 |
| Tahoe Vista | Two persons complained of septic tank failures that had occurred on neighboring property during previous years. These tanks were found to be operating satisfactorily at the time of inspection. Motel owners in Tahoe Vista complained of offensive sewage odors which were noticeable in the late evening. They felt that the odors were originating from septic ponded effluent at the North Tahoe P.U.D. sewage treatment plant. An inspection of the plant did not reveal sources of strong odors, but it was observed that an effluent pond was incipiently septic. Several weeks later a follow-up investigation found that the pond under suspicion had turned septic and odors were very offensive. A concentrated study was made throughout Tahoe Vista to find if any failing septic tank systems might be contributing to the report of odor nuisance. A failing septic tank leaching system was found near a store and cafe in this community. Odors were noticeable, especially late at night, but there was no overflow to nearby water supplies.<br>During this course of investigation, a failing septic tank was located next to the kitchen of a coffee shop. Odors were noticeable here at nighttime. |
| Carnelian Bay | One case of septic tank overflow was noted. A puddle had formed on the beach at a private cabin. Samples were collected. |

TABLE XXVII (continued)

| SECTOR | OBSERVATIONS AND SAMPLING DATA |
|---|---|
| Carnelian Bay (continued) | Results<br>Coliform MPN/100 ml 620,620<br>Fecal Coliform MPN/100 ml 23<br>ABS (mg/l) <0.1<br>Chloride (mg/l) 6.5<br>Nitrate (mg/l) <0.5 |
| Tahoe City | Samples of treated laundry wastes were collected. The laundry waste flows were being passed through a sedimentation basin and a slow sand filter. The effluent was passed through leaching lines to overflow in an open ditch, from which samples were collected.<br>Results<br>Coliform MPN/100 ml >24,000<br>>24,000<br>ABS (mg/l) 0.3<br>Chloride (mg/l) 0.8<br>No overflowing septic tank systems were found in the sector, and the Tahoe City P.U.D. sewage disposal facilities appeared to be operating satisfactorily, with no evidence of overflows to neighboring land or to the Truckee River. |
| Sunnyside | No evidences of failing sewage disposal systems were found in this sector in either phase of study.<br>An inspection of the Kaspian Recreation Area one-half mile north of Blackwood Creek in the Tahoe National Forest found the campground very clean and free from offensive odors. |

TABLE XXVII (continued)

| SECTOR | OBSERVATIONS AND SAMPLING DATA |
|---|---|
| Tahoma | A complaint was made of a septic tank failure during the previous season. An inspection of the premises showed the system now to be working satisfactorily. There were no evidences of septic tank failures in the sector in either study phase. |
| Rubicon | A complaint was made that, earlier in the season, sewage overflow from a resort facility had been entering Meeks Creek. A follow-up investigation was requested of the local health department. |
| Emerald Bay | One septic tank failure from a private cabin in the area was observed. Water supply sources were not threatened. Sewage disposal in Emerald Bay State Park was satisfactory. |
| Fallen Leaf Lake | Several permanent residents at Fallen Leaf Lake told of numerous cases of failure of individual sewage disposal systems which occurred during previous seasons. The sewage disposal systems for the Fallen Leaf Lake Lodge and the Stanford Sierra Camp resorts have had histories of failures. A slight increase of coliform bacteria in lake waters near the Stanford Lodge suggests that sewage effluents might be seeping into the lake through rock fissures.<br>Although thorough investigations revealed no other evidences of septic tank system failures, many installations on precipitous embankments very near the shoreline appeared to be marginally designed. |
| Tahoe Valley | Late in August, several sewage overflows were located and studied in the vicinity of the "Y", or the junction of Highways 50 and 89 in Tahoe Valley. Both of the overflows were occurring at service stations situated near this intersection. Septic tank effluent was ponding behind a Mobile Oil service station. An inadequately designed leaching system was thought to be the cause of the failure. Another sewage overflow was found at the same time |

TABLE XXVII (continued)

| SECTOR | OBSERVATIONS AND SAMPLING DATA |
|---|---|
| Tahoe Valley (continued) | at a neighboring Associated service station. Septic tank effluent was gushing from a hole which had been dug the day before in order to pump the tank. The sewage was flowing down the roadside and was ponding in front of some private cabins in the area. Sewage odors were very noticeable. Local health department officials were informed, and wells situated in the environs were sampled. The overflows did not reach nearby lakes or streams. No other sewage disposal failures were located within the sector. |
| Al Tahoe | The water quality relationship of an abandoned laundry sump 40 feet from a well was investigated. The sump had been abandoned and filled in November, 1960, reportedly. Analyses of the well water showed evidence that residual sump wastes were mingling with the well water. Most of the premises in the Al Tahoe sector are sewered. Remaining septic tank systems appeared to be operating satisfactorily. A complaint was made of a septic tank failure in a previous season. |
| Bijou | The developed neighborhoods in the Bijou sector are sewered. There were no evidences of sewage disposal practices which might affect water quality conditions. It was noted, however, that a service station in Bijou had been discharging oily wastes into Bijou Creek. Considerable amounts of trash had accumulated along the stream banks in the vicinity of the Bijou Shopping Center. |
| Stateline | During the Phase I period of study, it was noted that a liquid flow continued for several days down the center of Stateline Boulevard. Samples were collected and the analyses showed that the flow could be of sewage origin. Several samples were collected at one-block intervals along Stateline |

TABLE XXVII (continued)

| SECTOR | OBSERVATIONS AND SAMPLING DATA |
|---|---|
| Stateline (continued) | Boulevard. ABS analyses ranged from 0.8 to 2.1 mg/l and coliform bacteria ranged from 62,000 to 620,000 MPN/100 ml. The stream was traced to a street fissure in the neighborhood of the gambling casinos. A broken sewage force main was suspected.<br>The Tahoe Meadows Estates is a parcel of private lands situated near Stateline between Highway 50 and the lake shore. The neighborhood did not annex to the South Tahoe Public Utility District, and is not sewered. The area is known to have a high ground water table, with very wet meadows in normal years. There are histories of individual sewage disposal failures in the Estates. However, no such failures were found during this season of investigation. |

## C. SEPTIC TANK PUMPING PRACTICES

El Dorado County requires that commercial septic tank pumping firms must report the date, the customer's name and address, the number of load-trips, and the location of the wastes dumping site. This information must be filed with the county health department within a specific period of time. Those who rent and maintain chemical toilets must follow a similar procedure of reporting. Several septic tank pumping firms and others associated with this activity were contacted for information regarding disposal practices.

It has been a regular practice in the South Lake Tahoe area to dump septic tank sludges into a sewage pumping station. This has caused some odor complaint. A former practice of dumping these wastes into the primary settling tank at the South Tahoe P.U.D. sewage treatment plant was discontinued. Some pumpers interviewed told that tanked wastes were dumped on occasion at a refuse burial site on the Kingsbury grade road in Nevada. Others reported they were discharging their wastes at the county dump grounds near Meyers. Specific information of dumping places and practices is somewhat difficult to obtain from the operators.

The operator of a firm which rents and maintains chemical toilets revealed that chemical toilet and septic tank wastes could be dumped into certain sewer system manholes within the South Tahoe Public Utility District whenever the original system or chemical toilet was located within the District. In cases where a pumped septic tank was outside the District, the pumpers apparently could dispose of wastes at the Meyers dump for a fee of about $2, and at the sewage treatment plant for a somewhat higher fee.

Apparently, septic tank pumping firms situated in the South Lake Tahoe area can make a choice of dumping either at a dump on the Kingsbury grade, at South Tahoe P.U.D. manholes, and at the Meyers dump.

These wastes are usually dumped into small excavated sumps at the Meyers dump grounds. Creosote is sometimes mixed with the wastes for odor and fly breeding control; then a cover of soil is pushed over the sump when filled. Overflow is not likely, and if this did occur, the wastes would have to flow about a mile to Saxton Creek through undeveloped lands. There appear to be no water quality hazards created by septic tank pumping practices in the South Lake Tahoe area at this time.

The disposal methods practiced by operators in Tahoe City and in the Kings Beach-Tahoe Vista areas are very similar to those employed in the South Lake region.

The Tahoe City dump ground is situated about one mile north of town. The dump is located downstream from a public water supply diversion which serves the community. Though no overflows of dumped wastes were found, this is possible in times of heavy rains and polluted waters might reach Lake Tahoe. Little information was available concerning the septic tank pumping practices in Kings Beach.

# APPENDIX

## Lake Tahoe Basin Water Quality Survey - 1961

### INDEX TO APPENDIX

Title — Page

List of Lake Tahoe Sampling Stations . . . . . . . . . . A-1 - A-4

DATA SHEETS - Lake Tahoe Sampling Program . . . . . . . B-1 - B-62

DATA SHEETS - Fallen Leaf Lake Sampling Program . . . . C-1 - C-15

List of Plankton Organisms Found . . . . . . . . . D-1 - D-2

Lake Tahoe Basin Water Quality Survey -
Preliminary Plan . . . . . . . . . . . . . . . E-1 - E-3

## LAKE TAHOE SAMPLING STATIONS - SOUTH RUN

## DESCRIPTION OF SAMPLING STATIONS

| Station Number | Description |
|---|---|
| 1. | Chambers Lodge - 50 yards off beach |
| 2. | Mouth of McKinney Creek - 50 yards offshore |
| 3. | Sugar Pine Point Lodge - 50 yards offshore |
| 4. | Tahoma Beach - 50 yards offshore |
| 5. | Tahoe Marina - 50 yards off fuel dock |
| 6. | Water Intake at Tahoma - opposite cabin with sign "TAHOMA" |
| 7. | Sugar Pine Point - opposite beacon tower - 50 yards offshore |
| 8. | South of General Creek - pier between Sugar Pine Point and Meeks Bay |
| 9. | Meeks Bay - North Beach Pier - 50 yards off end of pier |
| 10. | Meeks Bay - Central Beach - 60 yards offshore |
| 11. | Meeks Bay Marina - opposite Chevron Fuel Dock |
| 12. | Meeks Bay South Beach - 100 yards offshore at South Beach swimming float |
| 13. | Rubicon Bay - North Cove - 50 yards offshore |
| 13-1/2. | Rubicon Point - 2 miles N.E. ("Background" sampling station) |
| 14. | Rubicon Bay - Launching Ramp - 50 yards offshore |
| 15. | Rubicon Bay - South Beach - 50 yards offshore |
| 16. | Rubicon Bay - Paradise Flat - 50 yards off beach |
| 17. | Bliss State Park Beach - 100 yards offshore |
| 18. | Emerald Bay - 100 yards off Vikingsholm Beach |

## Lake Tahoe Sampling Stations - South Run (continued)

| Station Number | Description |
|---|---|
| 19. | Baldwin Beach - at piling "B" |
| 20. | Camp Richardson - 100 yards W. of Edwards Boat Service Pier |
| 21. | Pope Beach at Jameson's Pier - 50 yards offshore |
| 22. | Pope Beach - at piling "H" |
| 23. | Tahoe Keys - Mouth of Marina - 50 yards offshore in Lake Tahoe |
| 24. | Mouth of Upper Truckee River - 100 yards offshore (shallow water) |
| 25. | Upper Truckee River - 600 yards offshore from mouth |
| 26. | West Point in Al Tahoe - 75 yards off Harootunian's |
| 27. | Globin's Pier - 50 yards offshore opposite beach |
| 28. | El Dorado County Camp Ground Beach - 250 yards offshore (shallow water) |
| 29. | Surf and Sand Beach at Bijou - 100 yards offshore |
| 30. | Connolly's Pier (the short one) - 50 yards offshore (D.W.R. Sampling Station #39) |
| 31. | Connolly's Intake - end of water intake marked by pipe and pink strip of cloth - 700-800 yards off Connolly's Pier |
| 32. | Mouth of Bijou Creek - creek near Bijou Center - 100 yards offshore |
| 33. | South Tahoe Marina - 50 yards offshore opposite beach |
| 34. | Tahoe Meadows Estates - 100 yards offshore in front of old pier |
| 35. | Lakeside Marina - at boat entrance to marina |
| 36. | Stateline Beach - 200 yards offshore near California-Nevada boundary |

## LAKE TAHOE SAMPLING STATIONS - NORTH RUN

## DESCRIPTION OF SAMPLING STATIONS

| Station Number | Description |
|---|---|
| 50. | Cal-Neva Lodge at Crystal Bay - 100 yards offshore |
| 50-1/2. | Brockway Pines - opposite resort beach - 50 yards offshore |
| 51. | Kings Beach Pier - opposite beach - 75 yards offshore |
| 52. | Moon Dunes - opposite private cabin of this name on sand dune |
| 52-1/2. | Tahoe Vista Beach - 75 yards offshore (shallow water) |
| 53. | Cottonwood Motel Intake - directly over water intake |
| 54. | Flick Point - opposite green boat shed - 50 yards offshore |
| 55. | Carnelian Bay - Sierra Boat Company Marina - 50 yards offshore |
| 56. | Mouth of Watson Creek - 50 yards offshore |
| 57. | Marker Buoy No. 8 - directly opposite |
| 58. | Dollar Point at Tennis Court - private court 50 yards offshore |
| 59. | Dollar Point Intake - directly over water intake pipe |
| 60. | Lake Forest - boat docks - 70 yards offshore |
| 61. | Safeway Pier at Tahoe City - 25 yards off pier |
| 62. | Tahoe City Marina - Tahoe City Boat Company marina entrance |
| 63. | Tahoe City P.U.D. Intake - directly over intake pipe |
| 64. | Lake Outlet at Tahoe City - 25 yards off float |
| 65. | Tahoe Tavern Pier - 25 yards off end of pier |
| 66. | Sunnyside Marina - 50 yards off beach |
| 67. | Mouth of Ward Creek - 50 yards offshore |

Lake Tahoe Sampling Stations - North Run (continued)

| Station Number | Description |
|---|---|
| 68. | Town and Country Beach - 50 yards offshore |
| 69. | Mouth of Blackwood Creek - 50 yards offshore |
| 70. | Mouth of Madden Creek - 50 yards offshore |
| 71. | Obexner's Marina - 25 yards off marina entrance |

# LAKE TAHOE DATA SHEETS

## Lake Water Sampling Program

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: [illegible] Lodge)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | 1030 | 64° | 5 | 15 | <0.1 | 2.5 | - | - | - | - | - | - |
| | 6-25 | - | - | 5 | 8.8 | <0.1 | 1.5 | - | - | - | - | - | - |
| | 6-26 | - | 62° | <2 | 2.2 | <0.1 | 1.5 | - | - | - | 0.05 | 67 | Glenodinium, Dinobryon |
| | 6-27 | 0905 | 62° | 2.2 | 8.8 | <0.1 | 1.5 | - | - | - | - | - | - |
| PHASE II | 8-22 | 1030 | 66 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 23 | 0945 | 64 | <4.5 | <4.5 | | | | | | | | |
| | 24 | 0900 | 64 | 4.6 | 6.0 | <0.1 | 0.5 | 2.0 | | | | | |
| | 25 | 0900 | 63 | 6 | 23 | <0.1 | 0.3 | 2.0 | | | | | |
| | 29* | 0915 | | 23 | 62 | <0.1 | 0.3 | 2.5 | | | | | |
| | 30 | 1305 | 62 | 6 | - | <0.1 | 0.5 | 2.0 | | | | | |
| | 9-2* | 0830 | - | 230 | 62 | 0.2 | 30 | 1.0 | | | | | |

*Truck run

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: [illegible] McKinney Creek)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | 1100 | 65° | 21 | - | <0.1 | 0.5 | - | - | - | 0.00 | 230 | - |
| | | | | 8.8 | | | | | | | | | |
| | 6-25 | - | - | 2.2 | 2.2 | <0.1 | 1.5 | - | - | - | 0.22 | 140 | Synedra, Clenodinium |
| | 6-26 | - | 63° | 8.8 | 15 | <0.1 | 1.5 | - | - | - | - | - | - |
| | 6-27 | 0910 | 62° | 8.8 | 240 | - | - | - | - | - | - | - | - |
| PHASE II | 8-22 | 1050 | 66 | 6 | <4.5 | <0.1 | 0.5 | 2.0 | <0.001 | <0.5 | <0.01 | 69 | Clenodinium |
| | 23 | 0950 | 64 | 6 | 6 | <0.1 | 0.5 | 2.0 | | | 0.01 | 100 | |
| | 24 | 0905 | 64 | 23 | 62 | <0.1 | 0.6 | 2.0 | | | 0.44 | 150 | |
| | 25 | 0905 | 63-1/2 | 23 | 62 | <0.1 | 0.3 | 2.0 | | | <0.01 | 110 | |
| | 29* | 0915 | - | 23 | 62 | <0.1 | 0.5 | 2.5 | | | 0.05 | 75 | |
| | 30 | 1305 | 62-1/2 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | 0.08 | 97 | |

* Truck run

[illegible] -HOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: [illegible]

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | 64° | 2.2 | 2.2 | - | - | - | - | - | - | - | - |
| | 6-25 | - | 64° | 2.2 | <2 | <0.1 | 0.5 | - | - | - | - | - | - |
| | 6-26 | - | 63° | 5 | 15 | <0.1 | 3.0 | - | - | - | - | - | - |
| | | | | | 8.8 | | | | | | | | |
| | 6-27 | 0915 | 62° | 8.8 | 5 | <0.1 | 1.5 | - | - | - | - | - | - |
| PHASE II | 8-22 | 1110 | 67 | 6 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 23 | 1005 | 65 | <4.5 | 6 | | | | | | | | |
| | 24 | 0910 | 64 | 50 | 23 | | | | | | | | |
| | 25 | 0910 | 63-1/2 | 6 | 6 | | | | | | | | |
| | 30 | 1300 | 63 | 13 | | | | | | | | | |

HOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION [illegible]

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 4.4 | <2 | - | - | - | - | - | - | - | - |
| | 6-25 | - | - | 2.2 | 2.2 | 0.10 | 0.50 | - | - | - | - | - | - |
| | 6-26 | - | 63° | 8.8 | >240 | - | - | - | - | - | - | - | - |
| | 6-27 | 0928 | 62 | 5 | 15 | <0.1 | 6.5 | | | | | | |
| PHASE II | 8-22 | 1115 | 67 | <4.5 | <4.5 | <0.1 | 0.5 | 1.0 | 0.0015 | <0.5 | | | |
| | 23 | 1010 | 65 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 24 | 0915 | 64 | 6 | 62 | <0.1 | 0.5 | 2.0 | | | | | |
| | 25 | 0920 | 63-1/2 | 6 | 23 | | | | | | | | |
| | 30 | 1300 | 62-1/2 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

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HOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION. ____

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | <2 | 7.6 | - | - | - | - | - | - | - | - |
| | 6-25 | - | - | 5 | <2 | - | - | - | - | - | - | - | - |
| | 6-26 | - | 62° | 38 | 240 | - | - | - | - | - | - | - | - |
| | | | | | 6.8 | | | | | | | | |
| | 6-27 | 0920 | 62° | 15 | 15 | 0.10 | 1.5 | - | - | - | - | - | - |
| PHASE II | 8-22 | 1125 | 67 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-23 | 1030 | 65 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-24 | 0940 | 64 | 6 | 23 | <0.1 | 0.3 | 2.0 | | | | | |
| | 25 | 0925 | 64 | 6 | 23 | | | | | | | | |
| | 30 | 1255 | 63 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #5 (Water Intake at [illegible])

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) SURFACE | COLIFORM (MPN/100 ml.) BOTTOM | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) TOTAL ALGAE | PLANKTON (org/ml) PREDOMINANT ORGANISM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHASE I | 6-24 | - | - | 2.8 | - | <0.1 | 0.50 | - | - | - | - | - | - |
| | 6-25 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 6-26 | - | 63° | 5 | 5 | <0.1 | 3.0 | | | | | | |
| | 6-27 | 0924 | 62° | 8.8 | 8.8 | <0.1 | 0.50 | | | | | | |
| PHASE II | 8-22 | 1130 | 67 | <4.5 | <4.5 | <0.1 | 0.4 | 2.0 | | | | | |
| | 23 | 1035 | 65 | <4.5 | 6.0 | | | | | | | | |
| | 25 | 0930 | 64 | 21 | <4.5 | | | | | | | | |
| | 30 | 1250 | 62-1/2 | <4.5 | | | | | | | | | |

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LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: [illegible]

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 2.2 | 35 | <0.2 | 0.50 | - | - | - | - | - | - |
| | 6-25 | - | 65° | 2.2 | 5 | - | - | - | - | - | - | - | - |
| | 6-26 | - | - | 2.2 | 8.8 | - | - | - | - | - | - | - | - |
| | | | | | <2 | - | - | - | - | - | - | - | - |
| | 6-27 | 0932 | 62° | 15 | 15 | - | - | - | - | - | - | - | - |
| PHASE II | 8-22 | 1145 | 67 | <4.5 | <4.5 | | | | | | | | |
| | 8-23 | 1040 | 65 | <4.5 | 6.0 | | | | | | | | |
| | 8-24 | 0950 | 65 | <4.5 | 23 | | | | | | | | |
| | 8-25 | 0935 | 64 | <4.5 | 23 | | | | | | | | |
| | 8-30 | 1245 | 63-1/2 | <4.5 | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #8 (South of General Creek)

|  | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) |  | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | SURFACE | BOTTOM |  |  |  |  |  |  | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 5 | - | - | - | - | - | - | - | - | - |
|  | 6-25 | - | 64° | 5 | <2 | - | - | - | - | - | - | - | - |
|  | 6-26 | - | 63° | 8.8 | 5 | - | - | - | - | - | - | - | - |
|  |  |  |  |  | 8.8 |  |  |  |  |  |  |  |  |
|  | 6-27 | 0935 | 62° | 2.2 | 5 | - | - | - | - | - | - | - | - |
| PHASE II | 8-22 | 1200 | 67 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 |  |  |  |  |  |
|  | 23 | 1055 | 66-1/2 | <4.5 | <4.5 |  |  |  |  |  |  |  |  |
|  | 25 | 0945 | 63-1/2 | 23 | 23 |  |  |  |  |  |  |  |  |
|  | 30 | 1240 | 63-1/2 | 4.6 |  |  |  |  |  |  |  |  |  |

### LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #9 (Meeks Bay - North Beach Pier)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/1) | (T.U.) | (mg/1) | (mg/1) | (mg/1) | (mg/1) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | 1145 | 64° | 2.2 | - | <0.1 | 5.0 | - | - | - | 0.03 | 180 | - |
| | | | | 8.8 | | | | | | | | | |
| | 6-25 | - | 66° | <2 | <2 | 0.10 | 0.50 | - | - | - | - | - | - |
| | 6-26 | - | 64° | 5 | 5 | | - | - | - | - | - | - | - |
| | | | | | 240 | | | | | | | | |
| | 6-27 | 0942 | 62° | <2 | 5 | <0.1 | 6.5 | - | - | - | - | - | - |
| PHASE II | 8-23 | 1105 | 66 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 24 | 1000 | 65 | <4.5 | 4.6 | <0.1 | 0.6 | 2.0 | | | | | |
| | 25 | 0955 | 64 | 6 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 26 | 0900 | 63-1/2 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 27 | 0845 | 61-1/2 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 29* | 0945 | - | <4.5 | <4.5 | <0.1 | 0.5 | 3.0 | | | | | |
| | 30 | 1235 | 63-1/2 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

* Truck run

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #10 (Meeks Bay - Central Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 15 | - | - | - | - | - | - | - | - | - |
| | | | | 27 | | | | | | | | | |
| | 6-25 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 6-26 | - | 63° | 38 | 8.8 | 0.20 | 2.5 | - | - | - | 0.08 | 170 | Glenodinium |
| | 6-27 | 0945 | 62° | 2.2 | <2 | - | - | - | - | - | - | - | - |
| PHASE II | 8-22 | 1205 | 67 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 23 | 1110 | 66 | <4.5 | <4.5 | | | | | | | | |
| | 24 | 1010 | 65 | <4.5 | <4.5 | | | | | | | | |
| | 25 | 1000 | 64 | 6 | <4.5 | | | | | | | | |
| | 26 | 0900 | 63 | <4.5 | <4.5 | | | | | | | | |
| | 27 | 0850 | 62 | <4.5 | <4.5 | | | | | | | | |
| | 30 | 1230 | 63 | <4.5 | - | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #11 (Meeks Bay - Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 15<br>240 | - | <0.1 | 3.0 | - | - | - | 0.38 | 480 | |
| | 6-25 | - | - | 2.2 | 240 | <0.1 | 1.5 | - | - | - | 0.50 | 100 | Glenodinium |
| | 6-26 | - | 63° | 240 | 240 | <0.1 | 7.0 | - | - | - | 0.13 | 4,300 | - |
| | 6-27 | 0950 | 62° | 240 | >240 | - | - | - | - | - | 0.03 | 2,600 | Cyclotella |
| PHASE II | 8-22 | 1210 | 67 | <4.5 | 6 | <0.1 | 0.4 | 2.0 | | | | | |
| | 8-23 | 1110 | 66 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.03 | 120 | Glenodinium |
| | 8-24 | 1015 | 65 | 13 | 130 | <0.1 | 0.6 | 2.0 | | | 0.65 | 200 | |
| | 8-25 | 1005 | 64 | <4.5 | <4.5 | <0.1 | 0.5 | 2.5 | | | 0.08 | 28 | |
| | 8-26 | 0900 | 63 | <4.5 | <4.5 | <0.1 | 0.3 | 1.5 | | | 0.11 | 48 | Glenodinium |
| | 8-27 | 0900 | 62 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.06 | 14 | |
| | 8-30 | 1225 | 63 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | 0.11 | 230 | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #12 (Meeks Bay - South Beach)

| | DATE | TIME | TEMP. ($^{o}F$) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 8.8 | - | - | - | - | - | - | - | - | - |
| | | | | 2.2 | | | | | | | | | |
| | 6-25 | - | 64° | <2 | 15 | - | - | - | - | - | - | - | - |
| | 6-26 | - | 64° | 12 | 38 | <0.1 | 1.5 | - | - | - | - | - | - |
| | | | | | 38 | | | | | | | | |
| | 6-27 | 0955 | 62° | 2.2 | 5 | | | | | | | | |
| PHASE II | 8-22 | 1215 | 67 | <4.5 | <4.5 | <0.1 | 0.4 | 2.0 | | | | | |
| | 8-23 | 1120 | 66 | <4.5 | <4.5 | | | | | | | | |
| | 8-24 | 1030 | 65 | 6 | <4.5 | | | | | | | | |
| | 8-25 | 1010 | 64 | 6 | 62 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-26 | 0915 | 63 | <4.5 | 4.6 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-27 | 0900 | 62 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-30 | 1220 | 63 | 6 | - | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #13 (Rubicon Bay - North Cove)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 2.2 | - | - | - | - | - | - | - | - | - |
| | | | | <2 | | | | | | | | | |
| | 6-25 | - | 66° | <2 | 2.2 | - | - | - | - | - | - | - | - |
| | 6-26 | - | 64° | <2 | <2 | - | - | - | - | - | - | - | - |
| | | | | | 5 | | | | | | | | |
| | 6-27 | 1000 | 62° | 2.2 | 15 | | | | | | | | |
| PHASE II | 8-22 | 1220 | 68 | <4.5 | <4.5 | | | | | | | | |
| | 8-23 | 1120 | 65 | <4.5 | <4.5 | | | | | | | | |
| | 8-30 | 1215 | 62 | <4.5 | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #[illegible]-1/2 (Rubicon Point - [illegible] N.E.)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | - | | - | - | | | | | | |
| | 6-25 | - | 66° | <2 | 10'- 5<br>20'-<2<br>30'-<2 | | | | | | | | |
| | 6-26 | - | 63° | <2 | 10'-<2<br>10'- 8.8<br>20'-<2<br>30'-15<br>50'- 5 | <0.1 | 1.5 | | | | 0.05 | 58 | Glenodinium, Dinobryon |
| | 6-27 | - | 63° | <2 | 10'-<2<br>20'-<2<br>30'-<2 | <0.1 | 1.5 | | | | 0.05 | 72 | Glenodinium |
| PHASE II | 8-24 | 1045 | 66 | <4.5 | 10'-<4.5<br>20'-<4.5<br>30'-<4.5 | <0.1 | 0.6 | 2.0 | | | 0.38 | 35 | Glenodinium |
| | 8-25 | 1015 | 65 | <4.5 | 10'-<4.5<br>20'-<4.5<br>30'-<4.5 | <0.1 | 0.3 | 2.0 | | | 0.21 | 48 | Glenodinium |
| | 8-30 | 1210 | 63.5 | <4.5 | | <0.1 | 0.5 | 2.0 | | | 0.03 | 66 | Glenodinium |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #14 (Rubicon Bay - Launching Ramp)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/l) | (T.U.) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 2.2 | - | <0.1 | 0.5 | | | | | | |
| | | | | 5 | | | | | | | | | |
| | 6-25 | - | 67° | 5 | 8.8 | - | - | - | - | | | | |
| | 6-26 | 1210 | 72° | 5 | <2 | | | | | | | | |
| | 6-27 | 1100 | 63° | 5 | 5 | - | - | - | - | | | | |
| PHASE II | 8-22 | 1240 | 67 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-23 | 1125 | 66 | <4.5 | <4.5 | | | | | | | | |
| | 8-24 | 1115 | 65.5 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-25 | 1050 | 64.5 | <4.5 | 9.4 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-30 | 1155 | 63 | <4.5 | | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #15 (Rubicon Bay - South Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | <2 | | | | | | | | | |
| | | | | <2 | | | | | | | | | |
| | 6-25 | | 68° | 5 | 5 | | | | | | | | |
| | 6-26 | - | - | - | - | | | | | | | | |
| | 6-27 | 1105 | 63° | 38 | 5 | | | | | | | | |
| PHASE II | 8-22 | 1245 | 68 | <4.5 | <4.5 | | | | | | | | |
| | 8-23 | 1135 | 68 | <4.5 | <4.5 | | | | | | | | |
| | 8-24 | 1125 | 65.5 | <4.5 | <4.5 | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #16 (Rubicon Bay - Paradise Flat)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/l) | (T.U.) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | <2 | - | | | | | | | | |
| | | | | 5 | | | | | | | | | |
| | 6-25 | - | 68° | 5 | <2 | <0.1 | 1.5 | | | | | | |
| | 6-26 | 1220 | 72° | 5 | 2.2 | <0.1 | 0.5 | | | | | | |
| | 6-27 | 1115 | 63 | 5 | <2 | | | | | | | | |
| PHASE II | 8-22 | 1255 | 68 | <4.5 | 6 | | | | | | | | |
| | 8-23 | 1140 | 67 | 6 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-25 | 1100 | 65 | <4.5 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-30 | 1150 | 63 | <4.5 | | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #17 (Bliss State Park - Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-24 | - | - | 2.2 | | | | | | | | | |
| | | | | 2.2 | | | | | | | | | |
| | 6-25 | - | 68° | <2 | 2.2 | | | | | | | | |
| | 6-26 | - | - | - | - | | | | | | | | |
| | 6-27 | 1125 | 63-1/2 | 2.2 | 15 | | | | | | | | |
| PHASE II | 8-22 | 1300 | 68 | <4.5 | <4.5 | | | | | | | | |
| | 8-23 | 1145 | 67 | 6 | <4.5 | | | | | | | | |
| | 8-24 | 1135 | 66 | <4.5 | <4.5 | <0.1 | 0.1 | 2.0 | | | | | |
| | 8-30 | 1145 | 63 | <4.5 | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #18 (Emerald Bay off Vikingsholm Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLORIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | 1315 | 74° | 2.2 | <2<br>2.2 | <0.1 | 7.0 | | | | 0.15 | 330 | Glenodinium |
| | 6-24 | - | - | 8.8<br>8.8 | - | | | | | | | | |
| | 6-25 | - | - | - | | | | | | | | | |
| | 6-26 | 1240 | 77° | 5 | <2 | <0.1 | 2.5 | - | - | - | 0.33 | 900 | Glenodinium |
| | 6-27 | 1145 | 65° | 38 | 15 | | | | | | | | |
| PHASE II | 8-23 | 1210 | 67 | <4.5 | 23 | <0.1 | 0.3 | 2.0 | | | 0.03 | 190 | |
| | 8-30 | 1120 | 64 | <4.5 | | <0.1 | 0.4 | 2.5 | | | 0.11 | 36 | Glenodinium |

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #19 (Baldwin Beach at Piling P)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | NO$_2$ (mg/1) | NO$_3$ (mg/1) | PO$_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | 2.2 | 2.2 | <0.1 | 0.5 | | | | | | |
| | 6-24 | - | - | 5 | - | <0.1 | 1.5 | | | | | | |
| | | | | 8.8 | | | | | | | | | |
| | 6-25 | - | 69-1/2° | <2 | Sample Broken | | | | | | | | |
| | 6-26 | 1300 | 66° | 7.6 | 5 | <0.1 | 0.5 | | | | | | |
| | 6-27 | 1155 | 64° | 5 | 8.8 | - | - | | | | | | |
| PHASE II | 8-23 | 1250 | 67 | <4.5 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1125 | 65 | <4.5 | 4.6 | | | | | | | | |
| | 8-30 | 1150 | 63 | <4.5 | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #[illegible] (Camp Richardson - Edwards Pier)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | NO$_2$ (mg/1) | NO$_3$ (mg/1) | PO$_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | 1245 | 73° | <2 | <2 | <0.1 | 0.5 | | | | | | |
| | 6-24 | - | - | 8.8<br>15 | | | | | | | | | |
| | 6-25 | - | 71° | 2.2 | 5 | <0.1 | 1.5 | | | | | | |
| | 6-26 | 1310 | 65° | 8.8 | <2 | <0.1 | 1.5 | | | | | | |
| | 6-27 | 1200 | 65° | 5 | 15 | <0.1 | 3.0 | | | | | | |
| PHASE II | 8-22 | 1325 | 68 | <4.5 | <4.5 | | | | | | | | |
| | 8-23 | 1325 | 69 | 62 | <4.5 | | | | | | | | |
| | 8-24 | 1150 | 67 | 6 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1130 | 66 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-26 | 0950 | 64 | <4.5 | <4.5 | <0.1 | 0.5 | 2.5 | | | | | |
| | 8-27 | 0945 | 66 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-29* | 1120 | - | <4.5 | <4.5 | <0.1 | 0.5 | 3.0 | | | | | |
| | 8-30 | 1100 | 62-1/2 | <4.5 | | | | | | | | | |

* Truck run

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #21 (Pope Beach at Jameson's Pier)

| | DATE | TIME | TEMP. ($^{o}$F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | 21 | 2.2 | | | | | | | | |
| | 6-24 | - | - | 20 | | <0.1 | 3.0 | | | | 0.03 | 570 | |
| | | | | 8.8 | | | | | | | | | |
| | 6-25 | - | 74° | <2 | 8.8 | | | | | | | | |
| | 6-26 | - | - | - | - | | | | | | | | |
| | 6-27 | 1210 | 67° | 8.8 | 15 | <0.1 | 0.5 | | | | | | |
| PHASE II | 8-22 | 1330 | 69 | 6 | <4.5 | | | | | | | | |
| | 8-23 | 1330 | 69 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-24 | 1200 | 67 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1140 | 66 | <4.5 | 21 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-26 | 1000 | 64 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-27 | 0950 | 67 | <4.5 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-30 | 1055 | 62-1/2 | <4.5 | - | <0.1 | 0.3 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #22 (Pope Beach at Piling "H")

|  | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) |  | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | SURFACE | BOTTOM |  |  |  |  |  |  | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | 1230 | 72° | Sample broken | 20 | <0.1 | 0.5 |  |  |  |  |  |  |
|  | 6-24 | - | - | 15<br>2.2 |  |  |  |  |  |  |  |  |  |
|  | 6-25 | - | - | - |  |  |  |  |  |  |  |  |  |
|  | 6-26 | 1320 | 65° | <2 | <2 | <0.1 | 1.5 |  |  |  |  |  |  |
|  | 6-27 | - | 68° | 5 | 8.8 |  |  |  |  |  |  |  |  |
| PHASE II | 8-21 |  | 72 | <4.5;<4.5 |  | <0.1 | 0.5 | 2.0 |  |  |  |  |  |
|  | 8-23 | 1400 | 69 | <4.5 | 6 |  |  |  |  |  |  |  |  |
|  | 8-24 | 1215 | 67 | 23 | 23 |  |  |  |  |  |  |  |  |
|  | 8-25 | 1150 | 66 | 23 | 9.2 |  |  |  |  |  |  |  |  |
|  | 8-30 | 1050 | 61.5 | <4.5 |  |  |  |  |  |  |  |  |  |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #23 (Tahoe Keys - Mouth of Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | 69° | >240 | - | <0.1 | 0.5 | - | - | - | 0.15 | 340 | Glenodinium |
| | 6-24 | 1345 | 76° | 8.8 | - | <0.1 | 11.0 | | | | 0.22 | 370 | - |
| | | | | 5 | | | | | | | | | |
| | 6-25 | - | 74° | 240 | 15 | <0.1 | 2.5 | | | | 0.10 | 550 | - |
| | 6-26 | 1410 | 66° | 5 | <2 | <0.1 | 5.0 | | | | 0.20 | 790 | |
| | 6-27 | - | 69-1/2° | 38 | 38 | <0.1 | 1.5 | | | | 0.27 | 890 | |
| PHASE II | 8-21 | 1015 | | | | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-22 | 1400 | 72 | (2) 6/<4.5 | (2) <4.5/<4.5 | <0.1 | 0.5 | 2.0 | 0.001 | <0.5 | 0.01 | 870 | |
| | 8-23 | 1400 | 70 | <4.5 | 6 | <0.1 | 0.8 | 2.0 | | | 0.28 | 600 | |
| | 8-24 | 1240 | 67 | <4.5 | 6 | <0.1 | 0.6 | 2.0 | | | 0.15 | 720 | |
| | 8-25 | 1100 | 66 | 23 | 9.2 | <0.1 | 0.5 | 2.0 | | | <0.01 | 460 | |
| | 8-26 | 1010 | 62 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | 0.09 | 440 | |
| | (1) 8-27 | 1000 | 68 | 7,000 | 620 | <0.1 | 0.5 | 2.0 | | | 0.14 | 230 | |
| | * 8-29 | 1230 | | 7,000 | >24,000 | <0.1 | 1.0 | 4.0 | | | 0.14 | 4,000 | |
| | 8-30 | 1035 | 61 | <4.5 | | <0.1 | 0.5 | 2.5 | | | 0.39 | 360 | |

(1) Cloudburst

* Truck run

(2) Coliform / fecal coliform

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #24 (Mouth of Upper Truckee River)

| | DATE | TIME | TEMP. ($^{o}$F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | 38 | >240 | <0.1 | 4.0 | | | | 0.27 | 1,600 | |
| | 6-24 | - | - | 38 | - | <0.1 | 3.0 | | | | 0.38 | 1,200 | |
| | | | | 38 | | | | | | | | | |
| | 6-25 | - | 73° | 240 | 38 | <0.1 | 3.0 | | | | 0.18 | 1,200 | |
| | 6-26 | - | - | - | | | | | | | | | |
| | 6-27 | - | 69-1/2 | 38 | 15 | <0.1 | 5.0 | | | | 0.32 | 1,800 | |
| PHASE II | 8-21 | | | 6 | | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-22 | 1415 | 74 | 12/<4.5 (1) | 13/<4.5 (1) | <0.1 | 1.2 | 2.0 | <0.001 | <0.5 | 0.20 | 7,200 | |
| | 8-23 | 1415 | 72 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.04 | 900 | |
| | 8-24 | 1255 | 67 | 6 | 23 | <0.1 | 0.6 | 2.0 | | | 0.38 | 1,000 | |
| | 8-25 | 1200 | 67 | 4.6 | <4.5 | <0.1 | 0.3 | 2.0 | | | 0.09 | 220 | (1) Coliform/fecal coliform |
| | 8-26 | 1025 | 61 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.10 | 340 | |
| | 8-27 | 1010 | 68 | 6 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.10 | 250 | |
| | 8-30 | 1025 | 60 | 4.5 | | <0.1 | 0.5 | 2.5 | | | 0.05 | 1,400 | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #25 (Upper Truckee River - 600 yards offshore)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | >240 | - | <0.1 | 3.0 | | | | | | |
| | 6-24 | - | - | 2.2 | | <0.1 | 1.5 | | | | | | |
| | 6-25 | - | - | - | - | | | | | | | | |
| | 6-26 | 1420 | 67° | 38 | >240 | 0.10 | 7.0 | | | | | | |
| | 6-27 | - | 70 | 38 | 38 | | | | | | | | |
| PHASE II | 8-21 | | | 23 | | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-24 | 1315 | 66.5 | <4.5 | 6 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-25 | 1210 | 67 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-30 | 1015 | 61 | <4.5 | | <0.1 | 0.4 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #26 (West Point - Al Tahoe)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) SURFACE | BOTTOM | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) TOTAL ALGAE | PREDOMINANT ORGANISM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHASE I | 6-23 | - | - | 38 | 38 | <0.1 | 4.0 | | | | 0.13 | 2,800 | |
| | 6-24 | - | - | 15 | 38 | <0.1 | 3.0 | | | | - | - | |
| | 6-25 | - | 75° | 7.5 | 2.2 | <0.1 | 3.0 | | | | | | |
| | 6-27 | | 71 | >240 | 38 | <0.1 | 5.0 | | | | | | |
| PHASE II | 8-21 | | | <4.5 | | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-22 | 1445 | 74 | | 23/<4.5 | | | | | | | | |
| | 8-23 | 1445 | 74 | <4.5 | 6 | <0.1 | 1.0 | 2.0 | | | | | |
| | 8-24 | 1325 | 68.5 | <4.5 | <4.5 | <0.1 | 1.2 | 2.0 | | | | | |
| | 8-30 | 1000 | 60 | <4.5 | | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #27 (Globin's Pier)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | 38 | 15 | <0.1 | 0.5 | | | | | | |
| | 6-25 | - | 74 | 8.8 | 5 | <0.1 | 2.5 | | | | | | |
| | 6-26 | 1430 | 68 | 38 | 15 | <0.1 | 5.0 | | | | | | |
| | 6-27 | - | 72 | 240 | 38 | <0.1 | 9.5 | | | | | | |
| | *6-27 | 10' | East | of pier | | <0.1 | 12.0 | | | | | | |
| | " | 150' | East | of pier | | 0.2 | 12.0 | | | | | | |
| | " | 300' | West | of pier | | <0.1 | 13.5 | | | | | | |
| | " | 100' | West | of pier | | <0.1 | 14.5 | | | | | | |
| | " | 150' | West | of pier | | 0.2 | 9.5 | | | | | | |
| PHASE II | 8-21 | - | 72 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-22 | 1450 | 72 | <4.5 / <4.5 (1) | 6 / <4.5 (1) | | | | | | | | |
| | 8-24 | 1345 | 69 | 6 | 50 | | | | | | | | |
| | 8-25 | 1220 | 66 | 6 | 4.6 | | | | | | | | |
| | 8-26 | 1045 | 63 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-27 | 1020 | 68 | 12 | 13 | <0.1 | 0.5 | 2.0 | | | | | |
| | *8-29 | 1300 | - | 62 | 62 | | | | | | | | |
| | 8-30 | 0950 | 60 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

* Truck run

(1) Coliform / fecal coliform

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #28 (El Dorado County Campground Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | - | - | 38 | >240 | <0.1 | 1.5 | | | | | | |
| | 6-25 | | 73 | 38 | 5 | <0.1 | 1.5 | | | | | | |
| | 6-27 | | 71-1/2 | 8.8 | 15 | <0.1 | 5.0 | | | | | | |
| | *6-27 | 100' | East | of boat | ramp | <0.1 | 33.0 | | | | | | |
| | " | 150' | " | " " | " | 0.1 | 28.0 | | | | | | |
| | " | 300' | " | " " | " | <0.1 | 30.0 | | | | | | |
| | " | 450' | " | " " | " | <0.1 | 29.0 | | | | | | |
| | " | Boat | ramp | | | <0.1 | 12.1 | | | | | | |
| PHASE II | 8-21 | - | 74 | 6 | - | <0.1 | 0.4 | 2.0 | | | | | |
| | 8-22 | 1500 | 72 | 62/<4.5 | 230/<4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-23 | 1435 | 72 | <4.5 | <4.5 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-24 | 1350 | 67-1/2 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1225 | 67 | 23 | <4.5 | | | | | | | | |
| | 8-26 | 1100 | 65 | <4.5 | <4.5 | <0.1 | 0.5 | 2.5 | | | | | |
| | 8-27 | 1030 | 66 | 23 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | *8-29 | 1315 | - | 7,000 | 2,400 | <0.1 | 2.2 | 3.0 | | | | | |
| | 8-30 | 0945 | 61 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

*Truck run

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #29 (Surf and Sand Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) SURFACE | COLIFORM (MPN/100 ml.) BOTTOM | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) TOTAL ALGAE | PLANKTON (org/ml) PREDOMINANT ORGANISM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHASE I | 6-23 | | 72 | 15 | 240 | <0.1 | 0.5 | | | | | | |
| | 6-25 | | 74 | 5 | 5 | <0.1 | 1.5 | | | | | | |
| | 6-27 | - | 72-1/2 | 15 | 240 | <0.1 | - | | | | | | |
| | 6-27* | End | of | pier | | <0.1 | 3.0 | | | | | | |
| | " | At | boat | ramp | | <0.1 | 14.5 | | | | | | |
| | " | 75' | west | of pier | | 0.1 | 8.5 | | | | | | |
| | " | Beach | west | end | | <0.1 | 8.5 | | | | | | |
| PHASE II | 8-21 | - | - | <4.5 | - | <0.1 | 0.4 | 2.0 | | | | | |
| | 8-22 | 1505 | 72 | <4.5/<4.5 | 6/<4.5 | <0.1 | 1.0 | 2.0 | 0.001 | <0.5 | | | |
| | 8-23 | 1440 | 72 | 23 | 6 | <0.1 | 1.8 | 2.0 | | | | | |
| | 8-24 | 1400 | 69 | <4.5 | <4.5 | <0.1 | 0.7 | 2.0 | | | | | |
| | 8-25 | 1230 | 67-1/2 | 4.6 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-26 | 1110 | 64-1/2 | <4.5 | 6 | <0.1 | 0.6 | 2.5 | | | | | |
| | 8-27 | 1040 | 65-1/2 | <4.5 | 62 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-30 | 0940 | 60 | 4.6 | - | <0.1 | 0.5 | 2.0 | | | | | |

*Truck run - shore samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #30 (Connolly's Pier)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/1) | (T.U.) | (mg/1) | (mg/1) | (mg/1) | (mg/1) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | | 72 | 21 | 240 | <0.1 | 1.5 | | | | | | |
| | 6-27 | | 72 | 38 | 38 | <0.1 | 1.5 | | | | | | |
| PHASE II | 8-23 | 1445 | 71 | 23 | 62 | | | | | | | | |
| | 8-29* | 1330 | | 6 | 23 | <0.1 | 0.7 | 2.0 | | | | | |

*Truck run - shore samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #31 (Connolly's Intake)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/l) | (T.U.) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | | | 15 | 240 | | | | | | | | |
| | 6-27 | | 70 | 11 | 38 | <0.1 | 1.5 | | | | 0.08 | 510 | Glenodinium |
| PHASE II | 8-24 | 1410 | 67 | <4.5 | <4.5 | <0.1 | 0.1 | 2.0 | | | | | |
| | 8-25 | 1240 | 66-1/2 | <4.5 | <4.5 | | | | | | | | |
| | 8-26 | 1118 | 65 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-27 | 1020 | 67-1/2 | 12 | 13 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-30 | 0935 | 61 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #32 (Mouth of Bijou Creek)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/1) | (T.U.) | (mg/1) | (mg/1) | (mg/1) | (mg/1) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | | | >240 | 38 | <0.1 | 0.5 | | | | | | |
| | 6-25 | | 74 | >240 | >240 | <0.1 | 2.5 | | | | | | |
| | 6-27 | | 73 | 240 | 38 | <0.1 | 8.5 | | | | 0.20 | 7,500 | |
| PHASE II | 8-21 | - | - | 23 | - | <0.1 | 0.9 | 2.0 | | | | | |
| | 8-22 | 1510 | 72 | <4.5/<4.5 (1) | 230/<4.5 (1) | <0.1 | 0.6 | 2.5 | <0.001 | <0.5 | | | |
| | 8-23 | 1450 | 71 | 6 | <4.5 | <0.1 | 0.3 | 2.0 | | | | | |
| | 8-24 | 1420 | 69 | 6 | 23 | <0.1 | 0.6 | 2.0 | | | | | |
| | 8-25 | 1245 | 67 | 62 | 23 | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-26 | 1125 | 63-1/2 | <4.5 | 4.6 | <0.1 | 0.8 | 2.5 | | | | | |
| | 8-27 | 1055 | 65-1/2 | <4.5 | 23 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-30 | 0930 | 60-1/2 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

(1) Coliform / fecal coliform

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #33 (South Tahoe Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | | | >240 | 240 | | | | | | | | |
| | 6-25 | | 74 | 2.2 | 2.2 | <0.1 | 2.5 | | | | | | |
| | 6-27 | | 74 | 38 | >240 | <0.1 | 9.5 | | | | 0.18 | 9,300 | |
| | 6-27* | Beach | - east | end | | <0.1 | 7.0 | | | | | | |
| | " | Beach | - west | end | | <0.1 | 7.0 | | | | | | |
| | " | Beach | at | center | | <0.1 | 17.5 | | | | | | |
| | " | Inside | boat | dock | | <0.1 | 14.5 | | | | | | |
| PHASE II | 8-21 | | | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-23 | 1500 | 72 | <4.5 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-24 | 1425 | 69 | 62 | 23 | <0.1 | 1.0 | 2.0 | | | | | |
| | 8-25 | 1250 | 67-1/2 | 62 | 6 | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-26 | 1135 | 65 | 4.6 | 6 | <0.1 | 0.8 | 2.0 | | | | | |
| | 8-30 | 0925 | 63 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

*Truck run - shore samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #34 (Tahoe Meadows Estates)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 5-23 | | | 38 | 36 | | | | | | | | |
| PHASE II | 8-21 | - | - | 6 | - | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-23 | 1505 | 71 | <4.5 | <4.5 | <0.1 | 0.7 | 2.0 | | | | | |
| | 8-24 | 1430 | 69 | 6 | 230 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1255 | 67-1/2 | 62 | 230 | | | | | | | | |
| | 8-30 | 0920 | 61 | <4.5 | - | <0.1 | 0.5 | 2.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #35 (Lakeside Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | 1110 | 72 | >240<br>240 | | <0.1 | 5.0 | | | | 0.33 | 1,300 | Glenodinium |
| | 6-25 | | 73 | 38 | 8.8 | <0.1 | 1.5 | | | | | | |
| | 6-27 | | | 38 | 240 | | | | | | | | |
| | 6-27* | Beach | W. | end | | <0.1 | 1.5 | | | | | | |
| | " | 250' | E. of | W. bound. | | <0.1 | 6.5 | | | | | | |
| | " | 400' | E. of | W. bound. | | <0.1 | 3.0 | | | | | | |
| | " | 350' | W. of | marina | | <0.1 | 3.0 | | | | | | |
| | " | 200' | W. of | marina | | <0.1 | 3.0 | | | | | | |
| | " | Harbor | exit | | | <0.1 | 6.5 | | | | | | |
| PHASE II | 8-21 | | | 23 | - | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-22 | 1520 | 71 | 23/<4.5 | 23/<4.5 | <0.1 | 0.6 | 2.0 | 0.0015 | <0.5 | | | |
| | 8-23 | 1510 | 70 | 6 | 6 | <0.1 | 0.5 | 2.0 | | | | | |
| | 8-25 | 1305 | 68 | 13 | 230 | | | | | | | | |
| | 8-30 | 0915 | 61 | <4.5 | | <0.1 | 0.5 | 2.5 | | | | | |

*Truck run - shore samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #36 (Stateline Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-23 | 1120 | 72 | 38<br>38 | | <0.1 | 3.0 | | | | 0.32 | 680 | Glenodinium |
| | 6-25 | | 71 | 15 | 38 | <0.1 | 2.5 | | | | 0.22 | | |
| PHASE II | 8-21 | | | <4.5 | | <0.1 | 0.4 | 2.0 | | | | | |
| | 8-22 | 1535 | 70 | <4.5/<4.5 | 6/<4.5 | <0.1 | 0.5 | 2.0 | 0.0015 | <0.5 | 0.01 | 150 | |
| | 8-23 | 1515 | 68 | <4.5 | 6 | <0.1 | 0.3 | 2.0 | | | 0.28 | 120 | |
| | 8-24 | 1435 | 67.5 | 13 | <4.5 | <0.1 | 0.8 | 2.0 | | | 0.36 | 1,900 | |
| | 8-25 | 1310 | 68 | 13 | 23 | <0.1 | 1.4 | 2.0 | | | 0.32 | 4,000 | |
| | 8-26 | 1145 | 66 | <4.5 | <4.5 | <0.1 | 0.5 | 2.0 | | | 0.22 | 1,400 | |
| | 8-30 | 0910 | 61 | 36 | 13 | <0.1 | 0.5 | 2.0 | | | 0.10 | 210 | |

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #50 (Cal-Neva Lodge at Crystal Bay)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1000 | | <2 | 8.8 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 0915 | | 2.2 | 38 | | | | | | | | |
| | 7-2 | 0915 | 63 | <2 | <2 | | | | | | | | |
| | 7-3 | 0940 | 61 | 8.8 | - | <0.1 | <0.5 | | | | <0.02 | 110 | Synedra, Glenodinium |
| | 7-4 | 0930 | 61 | <2 | 5 | <0.1 | 0.5 | | | <0.5 | | | |
| | 7-6 | 0935 | | <2 | <2 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-7 | 0945 | 61 | 2.2 | 2.2 | <0.1 | <0.5 | | | <0.5 | | | |
| PHASE II | 9-5 | 1000 | | 6 | <4.5 | <0.1 | 0.2 | 1.0 | | <0.5 | | | |
| | 9-8 | 0945 | 61 | 6 | | <0.1 | 0.0 | 0.1 | | | 0.13 | 49 | Glenodinium |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #50-1/2 (Brockway Pines)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | N O D A T A | | | | | | | | | | | | |
| PHASE II | *9-2 | 1445 | 65 | 6 | 6 | 0.3 | 0.8 | 1.7 | | | | | |
| | *9-3 | 0850 | 48.5 | <4.5 | | <0.1 | 1.0 | 1.0 | | | | | |
| | 9-5 | 1025 | | <4.5 | <4.5 | <0.1 | | 0.8 | | <0.5 | | | |
| | *9-6 | 1345 | | 23 | 62 | <0.1 | 0.1 | 0.7 | | | 0.09 | 450 | |
| | *9-7 | 1345 | | 23 | 6 | <0.1 | 0.0 | 0.0 | | | 0.01 | 920 | |
| | 9-8 | 1000 | 61 | 6 | | <0.1 | 0.0 | 0.9 | | | 0.27 | 190 | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #51 (Kings Beach Pier)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1030 | | 8.8 | 2.2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 0930 | | 8.8 | 8.8 | | | | | | | | |
| | 7-2 | 0930 | 63 | 5 | 8.3 | | | | | | | | |
| | 7-3 | 0950 | 63 | 38 | | <0.1 | <0.5 | | | | | | |
| | 7-4 | 0950 | 61 | 38 | 5 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-6 | 0945 | | 2.2 | 38 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-7 | 1000 | 61 | 38 | 15 | <0.1 | <0.5 | | | <0.5 | | | |
| PHASE II | *9-2 | 1430 | 65 | <4.5 | <4.5 | <0.1 | 0.7 | 0.8 | | | | | |
| | *9-3 | 0900 | 61 | 6 | 6 | <0.1 | 0.5 | 1.0 | | | | | |
| | 9-5 | 1015 | | 23 | 6 | <0.1 | 0.1 | 1.0 | | <0.5 | | | |
| | *9-6 | 1330 | | 62 | <4.5 | <0.1 | 0.0 | 0.4 | | | | | |
| | 9-7 | 1320 | | 21 | 6 | <0.1 | 0.5 | 0.9 | | | | | |
| | 9-8 | 1005 | 60 | 23 | | <0.1 | 0.0 | 0.0 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #51B (Brockway Water Intake)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 7-7 | 1015 | 61 | 5<br>38 | | <0.1 | 1.0 | | | <0.5 | | | |
| | 7-7 | 1030 | | <2 | 8.8 | | | | | | | | |
| PHASE II | 9-4 | | | <4.5 | | <0.1 | | 0.7 | | <0.5 | | | |
| | 9-5 | | | | <4.5 | <0.1 | | 0.7 | | <0.5 | | | |
| | 9-8 | | | | 6 | <0.1 | 0.0 | 0.9 | | | | | |

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #52 (Moon Dunes)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1035 | | <2 | <2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 0945 | | 2.2 | 2.2 | | | | | | | | |
| | 7-2 | 0935 | 63 | 2.2 | <2 | | | | | | | | |
| | 7-4 | 1000 | 61 | 8.8 | 8.8 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-6 | 0950 | | 2.2 | <2 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-7 | 1040 | 61 | 5 | 2.2 | | | | | | | | |
| PHASE II | *9-2 | 1400 | | <4.5 | | <0.1 | 0.6 | 0.9 | | | | | |
| | *9-3 | 0930 | 55 | 62 | | <0.1 | 1.7 | 0.6 | | | | | |
| | 9-4 | | | <4.5 | | <0.1 | | 0.5 | | <0.5 | | | |
| | 9-5 | 1040 | | <4.5 | 23 | <0.1 | 0.0 | 1.0 | | <0.5 | | | |
| | *9-6 | 1320 | | <4.5 | | <0.1 | 0.1 | 0.0 | | | | | |
| | *9-7 | 1310 | | 4.6 | | <0.1 | 0.3 | 0.1 | | | | | |
| | 9-8 | 1020 | | 6 | 23 | <0.1 | 0.0 | 0.3 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #52 1/2 (Tahoe Vista Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) SURFACE | COLIFORM (MPN/100 ml.) BOTTOM | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) TOTAL ALGAE | PLANKTON (org/ml) PREDOMINANT ORGANISM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHASE I | 7-7(1) | 1045 | | 5 | | | | | | | | | |
| | 7-7(2) | 1050 | | 15 | | | | | | | | | |
| | 7-7(3) | 1053 | | 2.2 | | | | | | | | | |
| PHASE II | *9-2 | 1345 | | 23 | | <0.1 | 1.0 | 1.1 | | | | | |
| | *9-3 | 1010 | 57 | 2,400 | | <0.1 | 1.9 | 1.0 | | | | | |
| | *9-3 | 0940 | 57.5 | 62 | | <0.1 | 1.6 | 0.0 | | | | | |
| | *9-3 | 0950 | 57 | 62 | | <0.1 | 1.6 | 0.0 | | | | | |
| | 9-4 | | | <4.5 | | | | | | | | | |
| | *9-7 | 1410 | | 62 | | <0.1 | 0.7 | 1.0 | | | | | |

* Truck samples

(1) Beach off Wood's Motel

(2) Beach off Jame's Resort

(3) Beach south of Sportman's Port

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #53 (Cottonwood Motel Intake)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | NO$_2$ (mg/l) | NO$_3$ (mg/l) | PO$_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1100 | | 5 | <2 | | | | | | | | |
| | 7-1 | 1005 | | <2 | 5 | | | | | | | | |
| | 7-2 | 0945 | 63 | <2 | <2 | | | | | | | | |
| | 7-3 | 1010 | 61 | 5 | - | <0.1 | <0.5 | | | | 0.05 | 160 | Glenodinium, Synedra |
| | 7-4 | 1015 | 61 | 2.2 | <2 | <0.1 | 0.5 | | | <0.5 | | | |
| | 7-6 | 1000 | | 2.2 | <2 | <0.1 | <0.5 | | | <0.5 | | | |
| | 7-7 | 1055 | 61 | 2.2 | 5 | | | | | | | | |
| PHASE II | *a. 9-2 | 1330 | | 7000 | | <0.1 | 0.8 | 0.5 | | | | | |
| | * 9-3 | 1000 | 57 | 23 | | <0.1 | 1.3 | 0.4 | | | | | |
| | 9-4 | | | <4.5 | | | | | | | | | |
| | 9-5 | 1110 | | <4.5 | <4.5 | <0.1 | | 1.0 | | <0.5 | | | |
| | * 9-6 | 1250 | | 6 | <4.5 | <0.1 | 0.3 | 0.2 | | | | | |
| | *b. 9-7 | 1250 | | 6 | | <0.1 | 0.4 | 0.3 | | | | | |
| | *c. 9-7 | 1250 | | 4.6 | | | | | | | | | |
| | * 9-7 | 1250 | | <4.5 | | | | | | | | | |
| | 9-8 | 1025 | 61 | 6 | | <0.1 | 0.1 | 0.1 | | | | | |

* Truck samples

a. Cottonwood Motel Beach

b. Beach 100 yards east

c. Beach 100 yards west

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #54 (Flick Point)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1115 | | <2 | 2.2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 1045 | | <2 | 2.2 | | | | | | | | |
| | 7-2 | 0955 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1025 | 61 | 38 | <2 | <0.1 | 0.50 | | | 0.20 | | | |
| | 7-6 | 1005 | | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1100 | 61 | <2 | 8.8 | | | | | | | | |
| PHASE II | 9-5 | 1125 | | <4.5 | 6 | <0.1 | | 0.0 | | <0.5 | | | |
| | 9-8 | 1035 | 61 | 6 | | <0.1 | 0.0 | 0.8 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #55 (Carnelian Bay - Sierra Boat Company)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/1) | (T.U.) | (mg/1) | (mg/1) | (mg/1) | (mg/1) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1130 | | <2 | 2.2 | <0.1 | 0.50 | | | | | | |
| | 7-1 | 1040 | | <2 | <2 | | | | | | | | |
| | 7-2 | 1000 | 64 | <2 | <2 | | | | | | | | |
| | 7-4 | 1040 | 61 | <2 | <2 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-6 | 1015 | | <2 | 5 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1118 | 61 | <2 | 5 | | | | | | | | |
| PHASE II | *9-2 | 1300 | 63 | 6 | 13 | <0.1 | 1.0 | 1.0 | | | | | |
| | *9-3 | 1030 | 57 | 6 | | <0.1 | 1.1 | 1.5 | | | | | |
| | 9-4 | | | <4.5 | | <0.1 | | 0.7 | | <0.5 | | | |
| | 9-5 | 1135 | | <4.5 | <4.5 | <0.1 | | 1.1 | | <0.5 | | | |
| | *9-6 | 1235 | | 4.6 | | <0.1 | 0.2 | 0.2 | | | 0.05 | 160 | |
| | *9-7 | 1235 | | 62 | | <0.1 | 1.0 | 0.6 | | | | | |
| | 9-8 | 1040 | 61 | 6 | | <0.1 | 0.0 | 0.1 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #56 (Mouth of Watson Creek)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1145 | | <2 | 8.8 | <0.1 | 0.70 | | | | | | |
| | 7-1 | 1100 | | 5 | 8.8 | | | | | | | | |
| | 7-2 | 1005 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1050 | 61 | 2.2 | 2.2 | <0.1 | 0.50 | | | <0.50 | 0.42 | 88 | Glenodinium |
| | 7-6 | 1020 | | 2.2 | 5 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1122 | 63 | 15 | <2 | | | | | | | | |
| PHASE II | *9-6 | 1225 | | 6 | | <0.1 | 0.0 | 0.2 | | | | | |
| | 9-8 | 1100 | 61.5 | <4.5 | | <0.1 | 0.0 | 0.2 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

**STATION:** #57 (Marker Buoy #8)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/l) | (T.U.) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1200 | | <2 | <2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 1105 | | 2.2 | 2.2 | | | | | | | | |
| | 7-2 | 1010 | 63 | <2 | 2.2 | | | | | | | | |
| | 7-4 | 1055 | 61 | 38 | <2 | <0.1 | <0.50 | | | 1.0 | | | |
| | 7-6 | 1025 | | <2 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1126 | 61 | <2 | <2 | | | | | | | | |
| PHASE II | 9-5 | 1145 | | <4.5 | 6 | <0.1 | | 0.7 | | <0.5 | | | |
| | 9-8 | 1115 | 61.5 | 62 | | <0.1 | 0.0 | 0.3 | | | | | |

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #58 (Dollar Point at Tennis Court)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1210 | | <2 | 2.2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 1110 | | 15 | <2 | | | | | | | | |
| | 7-2 | 1020 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1105 | 61 | <2 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-6 | 1035 | | 2.2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1130 | 61 | 2 | <2 | | | | | | | | |
| PHASE II | 9-5 | 1155 | | 6 | <4.5 | 0.2 | | 1.0 | | <0.5 | | | |
| | 9-8 | 1120 | 61.5 | 62 | | <0.1 | 0.0 | 0.2 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #59 (Dollar Point Intake)

|  | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) |  | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | SURFACE | BOTTOM |  |  |  |  |  |  | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1220 |  | <2 | 2.2 | <0.1 | 1.3 |  |  |  |  |  |  |
|  | 7-1 | 1120 |  | <2 | 2.2 |  |  |  |  |  |  |  |  |
|  | 7-2 | 1025 | 63 | <2 | <2 |  |  |  |  |  |  |  |  |
|  | 7-4 | 1115 | 61 | <2 | <2 | <0.1 | <0.50 |  |  | <0.50 |  |  |  |
|  | 7-6 | 1040 |  | <2 | <2 | <0.1 | <0.50 |  |  | <0.50 |  |  |  |
|  | 7-7 | 1137 | 62 | <2 | <2 |  |  |  |  |  |  |  |  |
| PHASE II | 9-5 | 1200 |  | <4.5 | <4.5 | <0.1 |  | 0.7 |  | <0.5 |  |  |  |
|  | 9-8 | 1130 | 61 | 6 |  | <0.1 | 0.1 | 0.5 |  |  |  |  |  |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #60 (Lake Forest)

|  | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) SURFACE | COLIFORM (MPN/100 ml.) BOTTOM | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) TOTAL ALGAE | PLANKTON (org/ml) PREDOMINANT ORGANISM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHASE I | 6-30 | 1230 |  | <2 | <2 | <0.1 | 0.60 |  |  |  |  |  |  |
|  | 7-1 | 1130 |  | 2.2 | <2 |  |  |  |  |  |  |  |  |
|  | 7-2 | 1030 | 63 | 5 | 2.2 |  |  |  |  |  |  |  |  |
|  | 7-4 | 1130 | 61 | <2 | 15 | <0.1 | 0.50 |  |  | <0.50 |  |  |  |
|  | 7-6 | 1045 |  | <2 | 5 | <0.1 | <0.50 |  |  | <0.50 |  |  |  |
|  | 7-7 | 1142 | 63 | 2.2 | <2 |  |  |  |  |  |  |  |  |
| PHASE II | *9-2 | 1210 | 61 | 230 | 620 | 0.2 | 1.8 | 1.2 |  |  |  |  |  |
|  | *9-3 | 1045 | 59 | 62 | <4.5 | <0.1 | 0.8 | 0.5 |  |  |  |  |  |
|  | 9-5 | 1215 |  | <4.5 | <4.5 | <0.1 |  | 1.0 |  | <0.5 |  |  |  |
|  | *9-6 | 1210 |  | 62 | 6 | <0.1 | 0.3 | 1.0 |  |  |  |  |  |
|  | *9-7 | 1220 |  | 620 |  | <0.1 | 1.6 | 0.4 |  |  |  |  |  |
|  | 9-8 | 1140 | 60 | 6 |  | <0.1 | 0.0 | 0.9 |  |  |  |  |  |

*Truck samples

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #61 (Safeway Pier at Tahoe City)

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/1) | (T.U.) | (mg/1) | (mg/1) | (mg/1) | (mg/1) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1300 | | <2 | 12 | | | | | | | | |
| | 7-1 | 1145 | | <2 | <2 | | | | | | | | |
| | 7-2 | 1040 | 63 | 2.2 | 5 | | | | | | | | |
| | 7-4 | 1145 | 61 | 5 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-5 | 1110 | 54 | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-6 | 1055 | | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1150 | 63 | 2.2 | 5 | | | | | | | | |
| PHASE II | *9-2 | 1125 | 59 | 62 | 23 | 0.2 | 2.6 | 1.2 | | | | | |
| | *9-3 | 1100 | 59 | <4.5 | <4.5 | <0.1 | 1.8 | 1.2 | | | | | |
| | 9-5 | 1225 | | <4.5 | <4.5 | <0.1 | | 0.5 | | <0.5 | | | |
| | *9-6 | 1145 | | <4.5 | 6 | <0.1 | 0.1 | 0.8 | | | 0.14 | 210 | Glenodinium |
| | *9-7 | 1200 | | 23 | | <0.1 | 0.0 | 0.7 | | | | | |
| | 9-8 | 1145 | 60.5 | 23 | | <0.1 | 0.2 | 0.9 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #62 (Tahoe City Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1315 | | <2 | 15 | <0.1 | 0.60 | | | | | | |
| | 7-1 | 1150 | | <2 | <2 | | | | | | | | |
| | 7-2 | 1050 | 63 | 5 | 2.2 | | | | | | | | |
| | 7-4 | 1150 | 63 | 2.2 | 8.8 | <0.1 | 1.0 | | | <0.50 | | | |
| | 7-5 | 1115 | 55 | 2.2 | 2.2 | <0.1 | 1.0 | | | <0.50 | | | |
| | 7-6 | 1100 | | <2 | 15 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1220 | 63 | <2 | 8.8 | <0.1 | <0.50 | | | <0.50 | | | |
| PHASE II | *9-2 | 1100 | 58 | 62 | 210 | 0.1 | 2.9 | 0.5 | | | | | |
| | *9-3 | 1115 | 60 | 6 | 23 | <0.1 | 0.7 | 0.8 | | | | | |
| | 9-5 | 1230 | | <4.5 | 6 | <0.1 | | 1.0 | | <0.5 | | | |
| | *9-6 | 1130 | | 62 | 23 | <0.1 | 0.3 | 0.8 | | | | | |
| | *9 7 | 1145 | | 62 | 130 | <0.1 | 0.0 | 0.1 | | | | | |
| | 9-8 | 1150 | 60.5 | <4.5 | | <0.1 | 0.0 | 0.4 | | | | | |

*Truck sample

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #63 (Tahoe City P.U.D. Intake)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLORIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1330 | | <2 | <2 | <0.1 | 1.2 | | | | | | |
| | 7-1 | 1155 | | <2 | <2 | | | | | | | | |
| | 7-2 | 1055 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1245 | 61 | <2 | <2 | <0.1 | 0.50 | | | <0.50 | <0.02 | 2.3 | |
| | 7-5 | 1100 | 55 | 2.2 | 15 | <0.1 | 1.0 | | | <0.50 | | | |
| | 7-6 | 1105 | | <2 | 8.8 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1222 | 62 | 5 | 2.2 | | | | | | | | |
| PHASE II | 9-4 | | | <4.5 | | <0.1 | | 0.5 | | <0.5 | | | |
| | 9-5 | 1240 | | <4.5 | | <0.1 | | 1.0 | | <0.5 | | | |
| | 9-8 | 1155 | | 23 | | <0.1 | 0.2 | 0.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #64 (Lake Outlet at Tahoe City)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1340 | | 2.2 | <2 | <0.1 | 0.60 | | | | | | |
| | 7-1 | 1200 | | 2.2 | <2 | | | | | | | | |
| | 7-2 | 1100 | 63 | 2.2 | 2.2 | | | | | | | | |
| | 7-4 | 1255 | 61 | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | 0.20 | 16 | Nougeotia, Glenodinium |
| | 7-5 | 1050 | 55 | <2 | 5 | <0.1 | 1.0 | | | <0.50 | | | |
| | 7-6 | 1115 | | <2 | 8.8 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1225 | 63 | <2 | <2 | | | | | | | | |
| PHASE II | *9-2 | 1040 | 57 | 23 | 23 | 0.1 | 1.6 | 0.1 | | | | | |
| | *9-3 | 1145 | 61.5 | 62 | 6 | <0.1 | 0.7 | 1.0 | | | | | |
| | 9-5 | 1345 | | <4.5 | <4.5 | <0.1 | | 0.8 | | <0.5 | | | |
| | *9-6 | 1120 | | 23 | 6 | <0.1 | 0.1 | 0.4 | | | | | |
| | *9-7 | 1135 | | 21 | | <0.1 | 1.4 | 0.6 | | | | | |
| | 9-8 | 1200 | 61 | <4.5 | | <0.1 | 0.0 | 0.9 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #65 (Tahoe Tavern Pier)

| | DATE | TIME | TEMP. ($^oF$) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1345 | | 5 | <2 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 1210 | | <2 | <2 | | | | | | | | |
| | 7-2 | 1110 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1305 | 61 | <2 | 8.8 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-5 | 1040 | 52 | 2.2 | <2 | <0.1 | 1.0 | | | <0.50 | | | |
| | 7-6 | 1120 | | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1228 | 63 | <2 | <2 | | | | | | | | |
| PHASE II | *9-3 | 1240 | 63 | 230 | | <0.1 | 0.6 | 0.9 | | | | | |
| | 9-4 | | | <4.5 | <4.5 | <0.1 | | 1.0 | | <0.5 | | | |
| | 9-5 | 1350 | | <4.5 | <4.5 | <0.1 | | 0.9 | | <0.5 | 0.02** | | * Truck sample |
| | 9-6 | 1100 | | 23 | | <0.1 | 0.1 | 0.8 | | | | 1600 | ** Sample of pool on beach |
| | *9-7 | 1100 | | 20** | | <0.1** | 0.6** | 0.2** | | | | | |
| | 9-8 | 1210 | 61 | <4.5 | | <0.1 | 0.0 | 0.0 | | | 0.51 | 110 | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #66 (Sunnyside Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1400 | | <2 | <2 | <0.1 | 0.60 | | | | | | |
| | 7-1 | 1220 | | <2 | 2.2 | | | | | | | | |
| | 7-2 | 1115 | 63 | <2 | 2.2 | | | | | | | | |
| | 7-4 | 1315 | 61 | 2.2 | 8.8 | <0.1 | 1.0 | | <0.50 | | | | |
| | 7-5 | 1025 | 52 | <2 | 2.2 | | | | | | | | |
| | 7-6 | 1130 | | <2 | 2.2 | <0.1 | <0.50 | | <0.50 | | | | |
| | 7-7 | 1233 | 61 | 2.2 | <2 | | | | | | | | |
| PHASE II | *9-2 | 1010 | 58 | 62 | 130 | 0.1 | 2.4 | 2.0 | | | | | |
| | *9-3 | 1315 | 64.5 | 13 | 62 | <0.1 | 0.5 | 1.1 | | | | | |
| | 9-4 | | | <4.5 | | <0.1 | | 0.7 | <0.5 | | | | |
| | 9-5 | 1400 | | 6 | 6 | <0.1 | | 1.1 | <0.5 | | | | |
| | 9-5 | 1405 | | <4.5 | | | | | | | | | |
| | *9-6 | 1045 | | 23 | <4.5 | <0.1 | 0.0 | 0.2 | | | | | |
| | *9-7 | 1040 | | 62 | 130 | <0.1 | 0.2 | 0.3 | | | | | |
| | 9-8 | 1220 | 61 | <4.5 | | <0.1 | 0.2 | 0.2 | | | | | |

*Truck samples

## LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #67 (Mouth of Ward Creek)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1415 | | <2 | <2 | <0.1 | 1.0 | | | | | | |
| | 7-1 | 1225 | | 2.2 | 15 | | | | | | | | |
| | 7-2 | 1125 | 63 | <2 | 4.4 | | | | | | | | |
| | 7-4 | 1325 | 61 | 15 | 2.2 | <0.1 | <0.50 | | | <0.50 | 0.28 | 210 | |
| | 7-5 | 1015 | 52 | 2.2 | 2.2 | <0.1 | 1.2 | | | <0.50 | | | |
| | 7-6 | 1140 | | <2 | 21 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1238 | 63 | 5 | 2.2 | | | | | | | | |
| PHASE II | 9-4 | | | <4.5 | <4.5 | <0.1 | | 1.0 | | <0.5 | | | |
| | 9-5 | 1415 | | <4.5 | 6 | <0.1 | | 1.2 | | <0.5 | | | |
| | *9-6 | 1025 | | <4.5 | | <0.1 | | 1.0 | | | | | |
| | 9-8 | 1225 | 61 | 6 | | <0.1 | 0.3 | 0.0 | | | | | |

*Truck sample

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #58 (Town and Country Beach)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1430 | | <2 | <2 | <0.1 | 1.2 | | | | | | |
| | 7-1 | 1230 | | 2.2 | <2 | | | | | | | | |
| | 7-2 | 1130 | 63 | <2 | <2 | | | | | | | | |
| | 7-4 | 1330 | 61 | <2 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-5 | 1005 | 52 | <2 | 5 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-6 | 1115 | | <2 | 2.2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1242 | 61 | 2.2 | <2 | | | | | | | | |
| PHASE II | *9-2 | 0940 | 56 | 2400 | >24,000 | <0.1 | 1.8 | 1.2 | | | | | |
| | *9-3 | 1340 | 65.5 | <4.5 | 6 | <0.1 | 2.8 | 1.0 | | | | | |
| | 9-4 | | | <4.5 | 13 | <0.1 | | 0.8 | | <0.5 | | | |
| | 9-5 | 1420 | | 6 | 6 | <0.1 | | 0.6 | | <0.5 | | | |
| | *9-6 | 1015 | | 23 | <4.5 | <0.1 | 0.2 | 0.8 | | | | | |
| | *9-7 | 1015 | | 6 | 13 | <0.1 | 0.1 | 0.5 | | | 0.02 | 60 | Glenodinium |
| | *9-7 | 1015 | | <4.5 | | <0.1 | 0.1 | 0.7 | | | | | |
| | *9-7 | 1015 | | 23 | | <0.1 | 0.3 | 0.1 | | | | | |
| | 9-8 | 1230 | 61.5 | 6 | | <0.1 | 0.1 | 0.2 | | | | | |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #69 (Mouth of Blackwood Creek)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1440 | | <2 | 38 | <0.1 | 1.5 | | | | | | |
| | 7-1 | 1240 | | 5 | 2.2 | | | | | | | | |
| | 7-2 | 1230 | 64 | 12 | 240 | | | | | | | | |
| | 7-4 | 1340 | 61 | 8.8 | 240 | <0.1 | <0.5 | | | <0.50 | 1.82 | 120 | |
| | 7-5 | 0950 | 52 | 15 | 21 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-6 | 1155 | | <2 | 38 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1255 | 62 | 2.2 | 5 | | | | | | | | |
| PHASE II | *9-3 | 1410 | 66 | 6 | | | | | | | | | |
| | 9-4 | | | <4.5 | <4.5 | <0.1 | | 0.5 | | <0.5 | | | |
| | 9-5 | 1425 | | <4.5 | 62 | <0.1 | | 1.1 | | <0.5 | | | |
| | *9-6 | 0945 | | 230 | | <0.1 | 1.0 | 0.2 | | | 0.02 | 250 | |
| | 9-8 | 1240 | 62 | 6 | | <0.1 | 0.0 | 0.8 | | | 0.42 | 67 | Glenodinium |

*Truck samples

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #70 (Mouth of Madden Creek)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1450 | | <2 | <2 | <0.1 | 0.6 | | | | | | |
| | 7-1 | 1245 | | <2 | 38 | | | | | | | | |
| | 7-2 | 1240 | 64 | 2.2 | 8.8 | | | | | | | | |
| | 7-4 | 1350 | 61 | 2.2 | <2 | <0.1 | 0.50 | | | <0.50 | 0.35 | 130 | |
| | 7-5 | 0940 | 54 | 8.8 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-6 | 1200 | | <2 | 8.8 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1300 | 61 | <2 | 5 | | | | | | | | |
| PHASE II | *9-6 | 0930 | | 62 | | <0.1 | 0.3 | 0.2 | | | <0.01 | 130 | |
| | 9-8 | 1245 | 61.5 | 21 | | <0.1 | 0.1 | 0.5 | | | | | |

*Truck sample

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #71 (Obexner's Marina)

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-30 | 1500 | | <2 | <2 | <0.1 | 1.2 | | | | | | |
| | 7-1 | 1255 | | 15 | 2.2 | | | | | | | | |
| | 7-2 | 1250 | 64° | 240 | 2.2 | | | | | | | | |
| | 7-4 | 1355 | 59 | 5 | <2 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-5 | 0930 | 54 | <2 | <2 | <0.1 | 0.50 | | | <0.50 | | | |
| | 7-6 | 1205 | | <2 | <2 | <0.1 | <0.50 | | | <0.50 | | | |
| | 7-7 | 1305 | 61 | <2 | 2.2 | <0.1 | 0.50 | | | <0.50 | | | |
| PHASE II | *9-2 | 0855 | | 62 | 620 | <0.1 | 1.2 | 0.8 | | | | | |
| | *9-3 | 1400 | 64 | <4.5 | <4.5 | <0.1 | 0.3 | 1.0 | | | | | |
| | 9-4 | | | <4.5 | 13 | <0.1 | | 0.5 | | <0.5 | | | |
| | 9-5 | 1445 | | 23 | 23 | 0.3 | | 1.3 | | <0.5 | | | |
| | 9-6 | 0915 | | <4.5 | 23 | <0.1 | 0.2 | 0.5 | | | | | |
| | *9-7 | 0920 | | <4.5 | 62 | <0.1 | 0.0 | 0.5 | | | | 48 | Glenodinium |
| | *9-7 | 0920 | | 6 | | <0.1 | 0.2 | 0.5 | | | | | |
| | *9-7 | 0920 | | 6 | | <0.1 | 0.1 | 0.7 | | | 0.09 | | |
| | 9-8 | 1255 | 62 | 230 | | <0.1 | 0.0 | 1.0 | | | 0.07 | | |

*Truck sample

## FALLEN LEAF LAKE DATA SHEETS

### Lake Water Sampling Program

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #1 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 5 | <0.1 | | | | | | | |
| | | | | | 15 | <0.1 | | | | | | | |
| | | | | *5 | | | | | | | | | |
| | 6-21 | | | | 5'- 5 | <0.1 | 1.0 | | | | 0.08 | 230 | Glenodinium |
| | | | | | 10'- 8.8 | <0.1 | 1.0 | | 0.002 | <0.5 | | | |
| | | | | | 20'- 7.6 | | | | | | | | |
| | | | | | 30'- 5 | | | | | | | | |
| | | | | | 10'- 5 | | | | | | | | |
| | | | | | 20'- 8.8 | | | | | | | | |
| | | | | *8.8 | | | | | | | | | |
| PHASE II | 8-26 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | | | | 230 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 62 | | <0.1 | | 1.0 | | | | | |
| | | | | 230 | | <0.1 | | 1.0 | | | | | |

* Tap Water

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #2 - Fallen Leaf Lake

| | DATE | TIME | TEMP. ($^oF$) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 8.8 | | | | | | | | |
| PHASE II | 8-26 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | | | | 62 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | | | | 23 | | <0.1 | | 1.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #[illegible] - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | *<2 | | | | | | | | |
| | | | | | 38 | | | | | | | | |
| | 6-21 | | | | *<2 | | | | | | | | |
| | | | | | 2.2; 4.4 | | | | | | 0.07 | 74 | Glenodinium |
| PHASE II | 8-26 | | | 13 | | <0.1 | | 1.0 | | | | | |
| | | | | 62 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | | | | 13 | | <0.1 | | 1.0 | | | | | |

* Tap Water

C-3

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #4 - Fallen Leaf Lake

|  | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) |  | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | SURFACE | BOTTOM |  |  |  |  |  |  | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-21 |  |  |  | 15 | <0.1 |  |  |  |  |  |  |  |
|  |  |  |  |  | 38 |  |  |  |  |  |  |  |  |
| PHASE II | 8-26 |  |  | 23 |  | <0.1 |  | 1.0 |  |  |  |  |  |
|  |  |  |  | 21 |  | <0.1 |  | 1.0 |  |  |  |  |  |
|  |  |  |  | 21 |  | <0.1 |  | 1.0 |  |  |  |  |  |
|  | 8-27 |  |  | 23 |  | <0.1 |  | 1.0 |  |  |  |  |  |
|  |  |  |  | 23 |  | <0.1 |  | 1.0 |  |  |  |  |  |
|  |  |  |  | 6 |  | <0.1 |  | 1.0 |  |  |  |  |  |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #5 - Fallen Leaf Lake

| | DATE | TIME | TEMP. | COLIFORM (MPN/100 ml.) | | ABS | TURB. | CHLO-RIDE | $NO_2$ | $NO_3$ | $PO_4$ | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (°F) | SURFACE | BOTTOM | (mg/l) | (T.U.) | (mg/l) | (mg/l) | (mg/l) | (mg/l) | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 8.8 | | | | | | | | |
| | | | | | >240 | | | | | | | | |
| | | | | | 2.2; 5 | | | | | | | | |
| | 6-21 | | | | 10'-2.2 | | | | | | | | |
| | | | | | 20'-4.4 | | | | | | | | |
| PHASE II | 8-26 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | | | | 23 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | <4.5 | | <0.1 | | 1.0 | | | | | |
| | | | | <4.5 | | <0.1 | | 1.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #6 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLORIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 15 | | | | | | | | |
| | 6-21 | | | | 10'-2.2 | | | | | | | | |
| | | | | | 20'-2.2 | | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

**STATION:** #7 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 5 | <0.1 | | | | | | | |
| | | | | | 2.2 | | | | | | | | |
| | 6-21 | | | | 10'-15 | | | | | | | | |
| | | | | | 25'-2.2 | <0.1 | 1.5 | | | | | | |
| | | | | 2.2 | <2 | | | | | | | | |
| | | | | | 2.2; <2 | | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

C-7

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #[illegible] - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 5 | | | | | | | | |
| | | | | | 38 | | | | | | | | |
| | | | | | 8.8 | <0.1 | | | | | | | |
| | | | | | 15 | | | | | | | | |
| | 6-21 | | | <2 | 2.2 | | | | | | | | |
| | | | | | 5 | | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #9 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 8.8 | | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #20 - Fallen Leaf Lake

| | DATE | TIME | TEMP. ($^{o}$F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 2.2 | | | | | | | | |
| | | | | | 38 | | | | | | | | |
| | 6-21 | | | 2.2 | <2 | | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

**STATION:** #11 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/1) | TURB. (T.U.) | CHLO-RIDE (mg/1) | $NO_2$ (mg/1) | $NO_3$ (mg/1) | $PO_4$ (mg/1) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 38 | <0.1 | | | | | | | |
| PHASE II | 8-26 | | | 230 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 6 | | <0.1 | | 1.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #12 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 2.2 | | | | | | | | |
| | | | | | 21 | | | | | | | | |
| | 6-21 | | | 2.2 | 10'-2.2 | | | | | | | | |
| | | | | | 20'-2.2 | | | | | | | | |
| | | | | 15 | | | | | | | | | |
| | | | | 4.4 | 2.2 | | | | | | | | |
| PHASE II | 8-26 | | | 13 | | <0.1 | | 1.0 | | | | | |
| | | | | 230 | | <0.1 | | 1.0 | | | | | |
| | | | | 2400 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 4.5 | | <0.1 | | 1.0 | | | | | |
| | | | | 60 | | <0.1 | | 1.0 | | | | | |
| | | | | 230 | | <0.1 | | 1.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #13 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 2.2 | <0.1 | | | | | | | |
| | 6-21 | | | 8.8 | 2.2 | | | | | | | | |
| PHASE II | 8-26 | | | 230 | | <0.1 | | 1.0 | | | | | |
| | 8-26 | | | ≥24,000 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 500 | | <0.1 | | 1.0 | | | | | |
| | | | | 6 | | <0.1 | | 1.0 | | | | | |

C-13

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #14 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | 8.8 | | | | | | | | | |
| | 6-21 | | | 5 | 15 | | | | | | | | |
| PHASE II | 8-26 | | | 23 | | <0.1 | | 1.0 | | | | | |
| | 8-27 | | | 620 | | <0.1 | | 1.0 | | | | | |

LAKE TAHOE WATER QUALITY STUDY 1961 - LAKE WATER SAMPLING PROGRAM

STATION: #15 - Fallen Leaf Lake

| | DATE | TIME | TEMP. (°F) | COLIFORM (MPN/100 ml.) | | ABS (mg/l) | TURB. (T.U.) | CHLO-RIDE (mg/l) | $NO_2$ (mg/l) | $NO_3$ (mg/l) | $PO_4$ (mg/l) | PLANKTON (org/ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SURFACE | BOTTOM | | | | | | | TOTAL ALGAE | PREDOMINANT ORGANISM |
| PHASE I | 6-20 | | | | 15<br>38<br>240 | <0.1 | | | | | | | |
| PHASE II | | | | | | | | | | | | | |

# LIST OF PLANKTON ORGANISMS FOUND

# LAKE TAHOE BASIN WATER QUALITY SURVEY

# 1961

## ALGAE (Genus Type)

### Blue Green (Myxophyceae)

Coccoid

- Anacystis
- Aphanocapsa
- Agmenellum

Filamentous

- Anabaena
- Lyngbya
- Oscillatoria
- Cylindrospermum
- Nodularia
- Phormidium

### Green (Chlorophyceae)

Coccoid

- Ankistrodesmus
- Closterium
- Chlorella
- Euastrum
- Oocystis
- Scenedesmus
- Tetraedron
- Arthrodesmus
- Cosmarium
- Coelastrum
- Micraetinium
- Pediastrum
- Staurastrum

Filamentous

- Mougeotia
- Zygnema
- Spirogyra

### Flagellates

Pigmented

- Dinobryon
- Euglena
- Lepocynclis
- Peridinium
- Unicellular Green Flagellates
- Eudorina
- Glenodinium
- Pandorina
- Trachelomonas

Unpigmented

- Distephanus (subject to reclassification)
- Paulinella
- Other Zooflagellates

### Diatoms (Bacillariophyceae)

Centric

- Cyclotella
- Melosira
- Stephanodiscus

## Lake Tahoe Basin Water Quality Survey

## LIST OF PLANKTON ORGANISMS FOUND (continued)

| | | |
|---|---|---|
| Pennate | Amphorea | Amphiprora |
| | Asterionella | Achnanthes |
| | Caloneis | Ceratoneis |
| | Cocconeis | Cymbella |
| | Cymatopleura | Denticula |
| | Diatoma | Diploneis |
| | Epithemia | Eucocconeis |
| | Eunotia | Fragilaria |
| | Frustulia | Gomphonema |
| | Hantzchia | Meridion |
| | Navicula | Nitzchia |
| | Pinnularia | Rhoicosphenia |
| | Rhopalodia | Synedra |
| | Stauroneis | Surirella |
| | Tabellaria | |

## OTHER PLANKTON (General Type)

| | | |
|---|---|---|
| Protozoa | | |
| Sacrcodina | Centropyxis<br>Euglyphidae | Diffugia<br>Wailesella |
| Ciliate | Aloricata | Paramecium |
| Macroplankton | | |
| Rotifers | Eosphora | Keratella |
| Copepoda | | |
| Nematoda | | |
| Tardigrada "little water bear" | | |

Water Quality Survey of

# LAKE TAHOE, FALLEN LEAF LAKE, DONNER LAKE, AND TRUCKEE RIVER AREAS

Preliminary Plan

## 1. Objective

To determine to what extent, if any, the present waste disposal practices (individual and community) affect the quality of surface and underground waters as sources of domestic water supply.

## 2. Dates of Extensive Field Sampling and Laboratory Analyses

June 19 - July 7, inclusive
August 21 - September 8, inclusive

## 3. Personnel Assigned

1. Gil Fraga
2. William Lee
3. Robert Kieffer
4. James Cornelius
5. Placer County Health Department Representative
6. El Dorado County Health Department Representative
7. Nevada County Health Department Representative
8. Other?

## 4. Procedures

A. Individual Water Supplies

1. Wells (representative number)
    - a. Data on depth and construction
    - b. Coliform analyses
    - c. Detergent analyses
    - d. Phosphate analyses
    - e. Nitrates, Nitrite, Ammonia Nitrogen
2. Surface Waters
    - a. Data on intakes, location from shore, docks, creeks, sanitary hazards, etc.
    - b. Coliform analyses
    - c. Detergent analyses
    - d. Phosphate analyses
    - e. Nitrates, Nitrite, Ammonia Nitrogen
    - f. Turbidity

B. Community Supplies

1. Wells - same data and analyses as for individual supplies

2. Surface Waters - same data and analyses as for individual supplies, plus turbidity and carbon filter sample at:

    a. Connolly's
    b. Meeks Bay
    c. Tahoe City
    d. Kings Beach
    e. Donner Lake
    f. Fallen Leaf Lake

3. Data on Number of Services, Range Number of People Served, Approximate Quantity Maximum and Minimum Daily

C. Waste Disposal

1. Individual Disposal Systems

    a. Locations, number, relation to water supply, percolation data, etc.
    b. Evaluation of effects on water quality
    c. Practices of septic tank sludge disposal

2. Community and Resort Disposal Systems

    a. General description of facilities
    b. Evaluation of effects on water quality

        1. Tahoe City
        2. Squaw Valley (2 plants)
        3. Truckee Sanitary District
        4. South Tahoe P.U.D.
        5. North Tahoe P.U.D.
        6. Brockway Resort
        7. Tahoe Tavern
        8. State Parks

3. Evaluation of Industrial Operations on Water Quality

    a. Log pond - Blackwood Creek
    b. Gravel washing operations - Madden Creek

D. Surface Water Investigations

1. Areas to be Surveyed

    a. Lakes - adjacent to populated areas
    b. Lakes - adjacent to confluences of creeks
    c. Streams - above, adjacent, and below populated areas

2. Analyses
    a. Temperature
    b. Coliform (emphasis on depth sampling in lakes)
    c. Phosphate
    d. $NO_3$
    e. ABS
    f. Turbidity
    g. Algae

5. Mobile Laboratory Locations

A. South Tahoe P.U.D. Sewage Treatment Plant (First Week?)

B. North Tahoe P.U.D. Sewage Treatment Plant

6. Mobile Laboratory Service

A. Approximate Daily Capacity
    1. 100 Coliform (5-10, 1-1, 1-0.1), plus
    2. 30 ABS, plus
    3. 30 $NO_3$, plus
    4. 100 Turbidity

B. Samples to be Prepared for Analyses in Berkeley
    1. Phosphate
    2. Algae

State of California

THE RESOURCES AGENCY

Lahontan Regional Water Quality Control Board

# LAKE TAHOE

# WATER QUALITY CONTROL POLICY

JUNE 1966

**EDMUND G. BROWN**
*Governor*
State of California

**HUGO FISHER**
*Administrator*
The Resources Agency

## STATE OF CALIFORNIA

Edmund G. Brown
Governor

THE RESOURCES AGENCY

Hugo Fisher
Administrator

---

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Executive Officer

## STATE WATER QUALITY CONTROL BOARD

## RESOLUTION NO. 66-

## APPROVING THE WATER QUALITY CONTROL POLICY FOR LAKE TAHOE ADOPTED BY THE LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

WHEREAS the Lahontan Regional Water Quality Control Board at a regular Board Meeting on June 23, 1966, adopted "Water Quality Control Policy - Lake Tahoe," including water quality objectives, by Resolution No. 66-11, and

WHEREAS the State Board has reviewed and considered this policy to determine compliance with statutory requirements, and

WHEREAS the State Water Quality Control Board finds as follows:

1. The California portion of Lake Tahoe is within the regulatory boundary of the Lahontan Regional Board.
2. A public hearing was held prior to adoption by the Regional Board and following appropriate notice.
3. The Regional Board has formulated and adopted a long-range plan and policy for water quality control of Lake Tahoe.
4. The policy conforms with the provisions of Chapter 1, Division 7 of the California Water Code (commencing with Section 13000).

now therefore be it

RESOLVED that the State Water Quality Control Board does hereby approve the water quality control policy for Lake Tahoe as adopted by the Lahontan Regional Water Quality Control Board.

## RESOLUTION 66-11
## ANNOUNCING THE ADOPTION BY THE LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD OF "WATER QUALITY CONTROL POLICY - LAKE TAHOE"

WHEREAS the Governor of the State of California in a letter dated November 24, 1965 strongly urged that this Board take immediate steps to establish effective water quality objectives to guarantee protection of the quality of the waters of Lake Tahoe, and

WHEREAS this Board on December 6, 1965 passed and adopted Resolution 65-15 announcing its intent to establish water quality objectives for Lake Tahoe at the earliest possible date and no later than June 30, 1966, as authorized by Division 7 of the California Water Code, and

WHEREAS the Board created a task force consisting of representatives of all interested state and county agencies of both California and Nevada, that held numerous meetings to formulate and review this policy, and

WHEREAS a public hearing was held on June 23, 1966 for the purpose of reviewing all comments of the public concerning the policy, and

WHEREAS this Regional Board has reviewed the policy and firmly believes it will protect the clarity and purity of the waters of Lake Tahoe and will protect all of the beneficial uses of Lake Tahoe including Aesthetics, Boating, Domestic Water Supply, Fish and Other Aquatic Life, Fishing, Industrial Water Supply, Irrigation Water Supply, Power Generation, and Water Contact Sports; now therefore be it

RESOLVED that the Lahontan Regional Water Quality Control Board does hereby adopt said policy as the Water Quality Control Policy for Lake Tahoe, and be it

FURTHER RESOLVED that this Board does fully intend to protect the water quality of Lake Tahoe by enforcing this policy through all means at its disposal, and be it

FURTHER RESOLVED that a copy of this resolution and policy be forwarded to the State Water Quality Control Board for its consideration as provided by in Section 13052.2 of the California Water Code.

Passed and adopted by the Lahontan Regional Water Quality Control Board No. 6 at a regular meeting of said Board held on June 23, 1966 by the following votes:

AYES:

NOES:

ABSENT:

ATTEST:

J. T. Leggett, Executive Officer

## AUTHORITY AND DIRECTIVES

The Legislature's directives, as contained in the California Water Code, places the following responsibilities upon the State and Regional Boards for formulating water quality control policy:

> Section 13000.3 requires that: "The regional and state boards . . . shall, at all times, coordinate their respective activities so as to achieve a unified and effective water quality control program in this state."
>
> Section 13022 requires that: "The state board shall formulate and adopt a statewide policy for control of water pollution with due regard for the authority of the regional boards . . . . ."
>
> Section 13022.1 requires that: "The state board shall formulate and adopt a statewide policy for water quality control . . . . ."
>
> Section 13052(e) requires that each regional board shall: "Formulate and adopt long-range plans and policies with respect to water pollution control and water quality control within the region . . . . ."
>
> Section 13052.2 requires that: "The regional board shall not adopt water pollution control or water quality control policy unless a public hearing is first held respecting the adoption of such policy.
> 'Any such water quality control policy shall become effective 60 days from the date of its adoption, unless specifically disapproved by the state board."

In addition, the federal government has placed the following responsibility upon each state or its water pollution control agency:

> The Federal Water Pollution Control Act calls upon each State or its water pollution control agency to file, by October 1, 1966, a letter of intent that, after public hearings, it will, before June 30, 1967, adopt (a) water quality criteria applicable to inter-state waters or portions thereof within such State, and (b) a plan for the implementation and enforcement of the water quality criteria adopted.

## TASK FORCE

John T. Leggett, Chairman
Fred M. McLaren, Project Coordinator

The Task Force was established by the Lahontan Regional Water Quality Control Board to assure that the interests of all public agencies were considered in this policy, and to acquire the technical assistance of qualified personnel in the various phases of water quality. Each agency completed a proposal for the sections of the policy of their concern. All proposals were reviewed by the Task Force at regularly scheduled meetings.

The Board is indebted to all members of the Task Force for their able assistance. Special recognition is given to James Cornelius, A. E. Greenberg, Sterling Davis, and Edward E. Whisman for their contributions to the "Water Quality Objectives" of the policy.

Recognition is given to Bertram G. Buzzini, Deputy Attorney General, State of California, for his assistance.

Maps and Cover Page were supplied by the Sacramento District, Department of Water Resources.

## MEMBERS

### State of California

Lahontan Regional Water Quality Control Board
  John T. Leggett, Executive Officer
  Fred R. McLaren, Associate Engineer

State Department of Public Health
  Paul C. Ward, Supervising Sanitary Engineer
  James Cornelius, Assistant Sanitary Engineer
  A. E. Greenberg, Chief, Sanitation and Radiation Laboratory

State Department of Fish and Game
  Sterling Davis, Pollution Bioanalyst

State Department of Water Resources
  Edward E. Whisman, Senior Engineer
  Bill B. Dendy, Associate Engineer

Placer County Health Department
Albert A. Marino, Chief, Division of Environmental Health

El Dorado County Health Department
John R. Thomson, Director of Sanitation

State of Nevada

Bureau of Environmental Health
Ernest G. Gregory, Chief

Fish and Game Commission
Thomas J. Trelease, Chief of Fisheries

Lake Tahoe Area Council
Charles A. Martin, Executive Director

## BOARD OF CONSULTANTS

The Board of Consultants for the Lake Tahoe Area Council are highly regarded experts in the field of water quality and are familiar with the water quality problems associated with Lake Tahoe. Their guidance and recommendations have been invaluable in formulating this policy.

Professor Percy H. McGauhey, B.S., M.S. (Chairman)
Professor of Sanitary and Public Health Engineering;
Chairman, Hydraulic & Sanitary Engineering Division;
Director, Sanitary Engineering Research Laboratory;
University of California, Berkeley, California

Professor Erman A. Pearson, B.S., M.S. Sc.D.
Professor of Sanitary Engineering
University of California, Berkeley, California

Professor Gerard A. Rohlich, B.S., M.S., Ph.D.
Professor of Civil Engineering
Director of Hydraulic and Sanitary Engineering Laboratories
University of Wisconsin, Madison, Wisconsin

Professor Rolf Eliassen, B.S., M.S., Sc.D.
Professor of Civil Engineering; Director of Sanitary Science Research Laboratory; and Member, Institute for Engineering-Economic Systems
Stanford University, Stanford, California

294

# LAKE TAHOE
# WATER QUALITY CONTROL POLICY

This Report Was Prepared For The
LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

Under The Supervision Of
John T. Leggett - Executive Officer

By
Fred R. McLaren - Associate Engineer

With Special Assistance By
The Lake Tahoe Task Force

* * * * *

## TABLE OF CONTENTS

Page

Organization . . . . . . . . . . . . . . . . . . . . . . . . . . i.
Letter of Transmittal, Governor, State of California . . . . ii.
Letter of Transmittal, State Water Quality Control Board . . iii.
Resolution Adopting Policy, State W.Q.C. Board . . . . . . . iv.
Resolution Adopting Policy, Lahontan Regional W.Q.C.Board. . v.
Authority and Directive. . . . . . . . . . . . . . . . . . . vi.
Task Force . . . . . . . . . . . . . . . . . . . . . . . . . vii.-viii.
Board of Consultants . . . . . . . . . . . . . . . . . . . . ix.
Title Page . . . . . . . . . . . . . . . . . . . . . . . . . x.
Table of Contents. . . . . . . . . . . . . . . . . . . . . . xi.

I. INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . 1.
- A. Statement of Problem. . . . . . . . . . . . . . . . . . 1.
- B. Objective of Policy . . . . . . . . . . . . . . . . . . 2.
- C. Rationale of Policy . . . . . . . . . . . . . . . . . . 2.

II. BENEFICIAL USES OF LAKE TAHOE. . . . . . . . . . . . . . . 4.
- A. Aesthetics. . . . . . . . . . . . . . . . . . . . . . . 4.
- B. Boating . . . . . . . . . . . . . . . . . . . . . . . . 5.
- C. Domestic Water Supply . . . . . . . . . . . . . . . . . 5.
- D. Fish and Other Aquatic Life and Fishing . . . . . . . . 6.
- E. Industrial Water Supply . . . . . . . . . . . . . . . . 7.
- F. Irrigation Water Supply . . . . . . . . . . . . . . . . 8.
- G. Power Generation. . . . . . . . . . . . . . . . . . . . 8.
- H. Water Contact Sports. . . . . . . . . . . . . . . . . . 8.

III. WATER QUALITY OBJECTIVES . . . . . . . . . . . . . . . . 10.
- A. Bacteriological Quality . . . . . . . . . . . . . . . . 10.
  - Coliform Organisms. . . . . . . . . . . . . . . . . . 10.
- B. Biological Enrichment . . . . . . . . . . . . . . . . . 11.
  - Plankton Growth Potential . . . . . . . . . . . . . . 11.
  - Soluble Phosphorus. . . . . . . . . . . . . . . . . . 11.
  - Total Soluble Nitrogen. . . . . . . . . . . . . . . . 11.
  - Plankton Count. . . . . . . . . . . . . . . . . . . . 11.
- C. Chemical Purity . . . . . . . . . . . . . . . . . . . . 11.
  - Specific Electrical Conductance . . . . . . . . . . . 11.
  - Chloride Ions . . . . . . . . . . . . . . . . . . . . 11.
  - Dissolved Oxygen. . . . . . . . . . . . . . . . . . . 11.
  - Hydrogen Ion Concentration as pH. . . . . . . . . . . 12.
- D. Physical Nature . . . . . . . . . . . . . . . . . . . . 12.
  - Clarity . . . . . . . . . . . . . . . . . . . . . . . 12.
  - Foreign Material. . . . . . . . . . . . . . . . . . . 12.
  - Taste and Odor Causing Substances . . . . . . . . . . 12.

Page

IV. POLICIES FOR THE CONTROL OF WATER QUALITY . . . . . . . . . . . . 13.
  A. Policy Regarding Disposal of Waste Waters of Other Deleterious Material to the Surface Waters of the Lake Tahoe Basin . . . . . . . . . . . . . . . . . . . . . . . . . 13.
  B. Policy Regarding Land Disposal of Waste Waters or Other Deleterious Materials Within the Lake Tahoe Basin. . 14.
  C. Policy Regarding Development on or Changes of the Shoreline. . . . . . . . . . . . . . . . . . . . . . . . 17.
  D. Policy Regarding Construction and Maintenance Practices in the Lake Tahoe Basin. . . . . . . . . . . . . 18.
  E. Policy Regarding Disposal of Wastes from Boats and Marinas. . . . . . . . . . . . . . . . . . . . . . 19.
  F. Policy Regarding Forestry Management in the Lake Tahoe Basin . . . . . . . . . . . . . . . . . . . . . 20.

V. AREA OF APPLICATION OR POLICY . . . . . . . . . . . . . . . . . . 22.
  A. Location of Study Area . . . . . . . . . . . . . . . . . . 22.
    Location of Study Area . . . . (Figure No. 1). . . . . . 23.
  B. Lake Tahoe Basin . . . . . . . . . . . . . . . . . . . . 22.
    Lake Tahoe Basin . . . . . . . (Figure No. 2). . . . . . 24.
  C. Developed Area and Land Use. . . . . . . . . . . . . . . . 22.
    Southern Section . . . . . . . (Figure No. 3). . . . . . 25.
    Central Section . . . . . . . (Figure No. 4). . . . . . 26.
    Northern Section . . . . . . . (Figure No. 5). . . . . . 27.

VI. SURVEILLANCE. . . . . . . . . . . . . . . . . . . . . . . . . . . 28.
  A. Sampling Program . . . . . . . . . . . . . . . . . . . . . 28.
    Sampling Stations. . . . . . . (Figure No. 6). . . . . . 31.
  B. Sampling, Testing, and Reporting Methods . . . . . . . . . 32.
  C. Evaluation of Results. . . . . . . . . . . . . . . . . . . 35.

VII. EXPLANATION OF WATER QUALITY OBJECTIVES . . . . . . . . . . . . 36.
  A. Bacteriological Quality. . . . . . . . . . . . . . . . . . 36.
    Coliform Organisms . . . . . . . . . . . . . . . . . . . 37.
  B. Biological Enrichment. . . . . . . . . . . . . . . . . . . 43.
    Plankton Growth Potential. . . . . . . . . . . . . . . . 43.
    Soluble Phosphorus . . . . . . . . . . . . . . . . . . . 43.
    Total Soluble Nitrogen . . . . . . . . . . . . . . . . . 44.
    Plankton Count . . . . . . . . . . . . . . . . . . . . . 44.
  C. Chemical Purity. . . . . . . . . . . . . . . . . . . . . . 45.
    Specific Electrical Conductance. . . . . . . . . . . . . 45.
    Chloride Ion Concentration . . . . . . . . . . . . . . . 47.
    Dissolved Oxygen . . . . . . . . . . . . . . . . . . . . 49.
    Hydrogen Ion Concentration as pH . . . . . . . . . . . . 49.
  D. Physical Nature. . . . . . . . . . . . . . . . . . . . . . 49.
    Clarity. . . . . . . . . . . . . . . . . . . . . . . . . 49.
    Foreign Material . . . . . . . . . . . . . . . . . . . . 51.
    Taste and Odor Causing Substances. . . . . . . . . . . . 51.

VIII. DEFINITION OF TERMS . . . . . . . . . . . . . . . . . . . . . . 52.

IX. REFERENCES. . . . . . . . . . . . . . . . . . . . . . . . . . . 53.

# CHAPTER I.

## INTRODUCTION

### A - STATEMENT OF PROBLEM

Lake Tahoe, located in the Sierra Nevada Mountains on the California-Nevada Border, is presently one of the clearest and most beautiful lakes in the world. The lake lies some 6,225 feet above sea level, is about 22 miles long, 12 miles wide, and has an area of approximately 192 square miles. It has a maximum depth of 1,645 feet, a mean depth of about 990 feet, and contains approximately 122 million acre-feet of water, or enough to cover the entire area of the State of California to a depth exceeding 14 inches.

Approximately 20 years ago the Lake Tahoe Basin was virtually uninhabited, but because of its beauty and unique location it has become a very popular year-around vacation area. Present population in the basin varies from about 50,000 during the winter months to a peak of approximately 150,000 during the late summer. Estimates of ultimate development of the basin have predicted that in the year 2010 the population would vary from about 110,000 during the winter months to a peak of approximately 600,000 in late summer.

The most attractive of the many attributes of the Tahoe Basin is the lake itself. Visitors and residents have said that the beautiful lake waters and the surrounding Sierra Nevada Mountains are comparable nowhere else in the world.

The great influx of population has created a serious problem in waste disposal, because any method presently economically feasible adds various chemical and biological substances to the basin and therefore to the lake itself. The many experts in the field of water quality who have studied the Lake Tahoe Basin have agreed that waste disposal methods which allow the concentrations of various chemical substances in the lake to increase will, if continued, eventually cause the lake waters to decrease in clarity, change in color, and, generally speaking, adversely affect its beneficial uses.

All who are associates with the Lake Tahoe Basin agree that deterioration of the quality of the waters of the lake would be detrimental to the economy of the area. All agree that impairment of the lake waters would mean the loss of one of the greatest natural resources in the United States.

Governors Edmund G. Brown of California and Grant Sawyer of Nevada in their joint statement on Lake Tahoe pollution stated that, "We, the Governors of California and Nevada, believe that the most important responsibility shared by our states is the preservation of the beauty of Lake Tahoe." This policy is a major step toward the assurance that Lake Tahoe will retain its present natural state of pristine purity and crystal clarity. The present quality is clearly defined as that quality to be maintained, and the many factors which adversely affect or which offer a potential impairment to the waters of Lake Tahoe are clearly stated and recommendations are made for controlling these factors. Governor Brown's vital interest in the preservation of the water quality of Lake Tahoe prompted him to ask his Lahontan Regional Water Quality Control Board to take immediate steps to establish effective water quality objectives for Lake Tahoe. The Regional Board, in response to the Governor's request, took immediate steps to establish this policy not later than June 30, 1966.

This policy, adopted by the Lahontan Regional Water Quality Control Board, is authorized by Division 7 of the California Water Code, and establishes the water quality control standards required by Section 10 of the Federal Water Quality Act of 1965 (Public Law 89-234.)

## B - OBJECTIVE OF POLICY

THE PRIME OBJECTIVE OF THIS WATER QUALITY CONTROL POLICY IS TO MAINTAIN THE WATERS OF LAKE TAHOE IN THEIR PRESENT NATURAL STATE OF CRYSTAL CLARITY AND PRISTINE PURITY, AND TO PROTECT ALL BENEFICIAL USES OF THE LAKE WATERS.

It is the intent of this policy to afford all necessary control on all unnatural factors which if not controlled will contribute to the impairment of Lake Tahoe. The policy affords a tool to all state, county, and local agencies for controlling the various factors relevant to the water quality of Lake Tahoe and controlling development in such a manner that will not permit uncontrollable problems of waste disposal to evolve. The policy also affords a tool for controlling development of the shoreline area that, if not controlled will result in impairment of the quality of the shallow waters of the lake and eventually the entire lake.

## C - RATIONALE OF POLICY

### Rationale of Water Quality Objectives

This policy establishes the present high quality of the lake waters as that quality to be maintained. There is reasonable assurance that by maintaining the various quality constituents at their present levels the lake waters will retain their present condition of clarity. Though the quality objectives contained in this policy are much more stringent than the usual criteria associated with beneficial uses, protection of the lake waters for aesthetic enjoyment requires that the quality not degrade.

The water quality objectives of this policy are stated in terms of four types of parameters, (Bacteriological Quality, Biological Enrichment, Chemical Purity, and Physical Nature.) Each parameter covers a specific aspect of water quality. Together they include all factors necessary to describe the water quality conditions of Lake Tahoe. Specific indicators were selected to represent each parameter. The selected indicators are the specific water quality objectives and are used in evaluating water quality as it relates to its parameter. Numerical values assigned to each indicator are based upon the most recent data available and reflect the present water quality conditions.

## Rationale of Policies for the Control of Water Quality

The best and most practical method of controlling factors that are detrimental to water quality are included in this section.

Controls are established regarding methods of waste disposal within the basin. Suggestions are made for controlling development that could result in serious waste disposal problems. Controls are recommended regarding changes in the physical nature of the lake which could result in undesirable water quality in the shoreline areas.

Adherence to these policies will assure to the best of our knowledge the protection of the clarity and purity of the waters of Lake Tahoe.

# CHAPTER II.

## BENEFICIAL USES OF LAKE TAHOE

Listed below are the beneficial uses of Lake Tahoe. Included is a description of how the lake waters presently fulfill each beneficial use, and the present and estimated future extensiveness of each use. This policy is intended to protect any and all below listed uses both now and in the future.

### A - AESTHETICS

Since that St. Valentine's Day, February 14, 1844, when Captain John C. Fremont climbed to the top of Red Lake Mountain and gazed upon the large and beautiful alpine lake, Lake Tahoe has continued to provide aesthetic inspiration and fascination to a host of succeeding generations. This is not surprising, for this lake has long been noted for its primitive and open character, its mountains and scenic beauty, and its dramatic lake setting. The Lake Tahoe Basin has long since emerged as one of the finest tourist centers of the Nevada-California Region.

The magnificent snow-capped mountain backdrop of the lake reflected in the water evokes a magical and wonderful appeal which attracts people by the thousands to its shores. The Lake Tahoe Watershed plays a major role as a recreation area for California and Nevada and exercises a dominance upon the outdoor recreational and other leisure activities of California and Nevada residents. It is likely that the region's future influence will be stronger and gain even greater popularity.

Lake Tahoe lies within a four hour drive of some three million people and scarcely more than one day's drive of nearly 10% of the total population of the United States. To these people it is more than commonly important because the semi-arid climate in which they live places severe limits on their use of water for recreational purposes. The lake's magnetic attraction for urban dwellers will be markedly boosted as the need for playlands increases and as the basin's scenic beauty wins even greater appreciation.

Only Crater Lake in Oregon and Lake Baikal in Russia rival Lake Tahoe's clarity of water. There are reports from Russia that Lake Baikal is losing its clarity through eutrophication. Efforts must be intensified to protect Lake Tahoe from a similar fate.

The preservation of the clarity and beauty of the lake waters is essential in order to keep it as a major national recreational asset. Mark Twain probably said it best many years ago when, after declaring Lake Tahoe "The fairest picture the whole earth affords." he went on to eulogize in this ageless prose:

> "In the early morning one watches the silent battle of dawn and darkness on the waters of Tahoe with a placid interest but when the shadows skulk away and one by one the hidden beauties of the shore unfold themselves in the full splendor of noon: when the smooth surface is belted like a rainbow with broad bars of blue and green and white, half the distance from circumference to center, when in the lazy summer afternoon, he lies in a boat far out to where the dead blue of the deep water begins and smokes the pipe of peace and idly winks at the distant crags and patches of snow from under his cap brim: when the boat drifts shoreward to the white water, and he lolls over the gunwale and gazes by the hour down through the crystal depths and notes the color of the pebbles and reviews the finny armies gliding in procession a hundred feet below: when at night he sees moon and stars, mountain ridges feathered with pines, jutting white capes, bold promontories, grand sweeps of rugged scenery topped with bald glimmering peaks, all magnificently pictured in the polished mirror of the lake, in richest, softest detail the tranquil interest that was born with the morning deepens and deepens, by sure degrees, till it culminates at last in resistless fascination."

## B - BOATING

Boating is one of the more important uses of Lake Tahoe. Among the hundreds of boats found on the lake on an average summer day are one man skiffs, motor boats for fishing, skiing, and simply pleasure riding, sail boats, excursion boats and, at times, the ultra-powerful hydroplanes. Boating activity has increased steadily over the years. The number of Coast Guard registered craft at Lake Tahoe in 1957 varied between 750 and 1,000 (1). The present number of boats, of course, is much greater. One estimate, that of the Regional Plan, is that boat launching and marina facilities should be provided in 1980 for 12,000 boaters at one time.

## C - DOMESTIC WATER SUPPLY

Lake Tahoe serves as a source of potable water for many integrated water systems as well as for private homes (1). It was found during a survey in 1961 that approximately 40% of the summer population within the California portion of the lake was served water from Lake Tahoe. Others are served water from streams, springs, or wells. Table 1 is a tabulation of the lake water systems in use during the summer of 1961 in California (2).

TABLE 1.

| Type | Estimated Population Served - 1961 |
|---|---|
| 18 Water Companies | 12,200 |
| 7 Resorts | 1,600 |
| State and Federal Campgrounds | 2,400 |
| 60 Known Private Homes | 300 |
| | 16,500 |

In Nevada, 6 large systems have lake intakes. Also, there are about a dozen small integrated systems having 6-8 consumers and many individual intakes serving households.

A comparison of the chemical composition of the lake waters with the Public Health Service Drinking Water Standards (3) shows the excellent chemical quality of the lake waters. The bacteriological quality is also excellent. The intakes of all lake supplies, particularly those located in shallow waters, are subject to hazard from boaters, swimmers, and water skiers. The use of lake waters without chlorination is discouraged.

As the development of the Lake Tahoe Basin progresses, additional use will be made of the lake waters for domestic purposes.

## D - FISH AND OTHER AQUATIC LIFE AND FISHING

Game fish inhabiting Lake Tahoe include lake trout "mackinaw," rainbow trout, brown trout, brook trout, kokanee salmon, and mountain whitefish, (4), (5).

Because of its great size, depth, and cold temperatures, Tahoe is ideal lake trout habitat. In California, the lake trout is restricted to the Tahoe-Truckee drainage basin where it is found in Tahoe, Donner, Fallen Leaf, and Stony Ridge Lakes.

The lake trout was introduced into Tahoe in 1895 and was well established by 1920. Early authenticated records show a lake trout caught weighing 33 pounds, although larger fish have been reported. These fish spawn in the fall in rocky-rubble areas of the lake at depths approximating 100 feet.

The rainbow trout is readily taken from boat or shore with fishing tackle less specialized than that required for lake trout. This species has been planted into the lake many times, earlier in the form of small fingerling fish, but more recently as catchables and larger trout. Incomplete records indicate that early introductions occurred prior to 1900. At present, the rainbow forms an important part of the topline and shore angler's catch. Rainbow trout ascend tributary streams of Lake Tahoe in the spring to spawn.

The brown trout, a fall spawning fish, ascends the tributary streams in October and November to propagate its species. This colorful trout is believed to have been introduced in the early 1900's. The occurrence of this species in the creel of the fisherman is slight compared to the lake trout and rainbow; however, those caught are usually of large size.

The brook trout, a fall spawner, was first planted into the lake in 1888, and later in 1956. Thus far, this species has not been able to adapt to lake conditions and is only rarely taken by the angler.

The kokanee salmon is present in the lake in small numbers. They are seldom caught by fishermen except during the fall spawning run of this species. These landlocked salmon spawn in several of the tributary streams during November and die shortly after spawning is completed. Kokanee were introduced in the late 1940's and early 1950's as a game and forage fish.

The California and Nevada Departments of Fish and Game jointly conducted a creel census at Lake Tahoe from September 1960 through 1963 (5). The estimated total use for 1962 was 47,732 angler-days. The total catch was 20,018 fish. About 60 percent of the catch was lake trout, with "wild" rainbow and planted trout comprising 21 and 17 percent respectively.

The origin of Tahoe anglers varied seasonally. About one-fourth of all angling effort was by California anglers living within five miles of Lake Tahoe. Other significant areas of origin were the San Francisco Bay area, the Los Angeles area, central California, and the Reno-Sparks area.

Unique deepwater plant beds now exist in the lake. The presence of this unusual community is not well known but the plants occur at depths from 100 to 400 feet around the lake and support a variety of invertebrate life which depends on them for food and shelter. The plants and invertebrates are considered to play an important part in the food chain of Lake Tahoe fishes and are of great scientific interest.

Outdoor recreation will loom as an increasingly important activity in California. Demand for trout fishing in California the next few years is expected to increase roughly in proportion to population growth. Anglers spent 3,185,000 days seeking wild trout and 3,620,000 for planted catchables in 1963. By 1980, total demand for trout is expected to be between 11,000,000 and 12,000,000 user days per year. California trout anglers probably spent well over $100,000,000 on their sport in 1963.

## E - INDUSTRIAL WATER SUPPLY

The ideal quality of water required for industrial use varies widely and is dependent upon the specific use. In the Lake Tahoe area, which is primarily a resort and recreational area, industrial development is almost nonexistent. Industrial use of Lake Tahoe waters may exist on the Truckee River in the vicinity of Reno and Sparks and future industrial development could occur at certain points in the Lake Tahoe shoreline.

The Water quality of Lake Tahoe would be excellent for nearly all industrial processes since few waters throughout the Nation are of a better quality.

## F - IRRIGATION WATER SUPPLY

Water quality criteria developed for irrigation use include limiting values for total dissolved solids or electrical conductivity, chloride ion, percent sodium, and boron. The historical values for all these constituents in Lake Tahoe have been far below the recommended limiting values for agricultural criteria. The lake waters are therefore an excellent source of water for irrigation purposes.

Agricultural use of Lake Tahoe water originated in 1858 when water was diverted from the Truckee River and its tributaries for irrigation of the Truckee Meadows near Reno. Irrigation use has increased steadily from that year. Irrigation use of water is covered by priorities (the Truckee River Decree) and is rigidly controlled by the States of California and Nevada. Within the Tahoe Basin, irrigation use of Lake Tahoe waters consists primarily of lawn and shrubs watering.

## G - POWER GENERATION

The primary water quality factors associated with power generation are corrosiveness and the erosive characteristics caused by suspended loads of fine, sharp grained particles. The waters of Lake Tahoe are used downstream in the Truckee River for power development by the Sierra Pacific Power Company. The quality of these waters has historically been entirely satisfactory for this use.

Use of Lake Tahoe water via the Truckee River for power generation began as early as 1891 when the predecessors to the Sierra Pacific Power Company built five power plants on the Truckee River from Floriston, California, to Reno, Nevada. The maximum diversion for any one of these five power plants is 550 acre feet per day at the Farad Plant, which was built in 1898.

## H - WATER CONTACT SPORTS

On a warm summer day thousands of swimmers and water skiers are found scattered throughout the 71-mile shoreline of Lake Tahoe. During the warmer days of July, August, and September, the public beaches are crowded to near capacity (1).

It is expected that water-contact recreation will increase as rapidly as facilities will allow. The shallow waters along the northern and southern shores will continue to be the more popular areas, but increased demand will result in increased use throughout the lake.

The water quality for water-contact sports is excellent. The bacteriological quality provides a high degree of protection to those using the waters for water-contact sports.

# CHAPTER III.

## WATER QUALITY OBJECTIVES

The intent of this water quality control policy is to maintain the waters of Lake Tahoe in their present natural state of crystal clarity and pristine purity, and to protect all beneficial uses of the lake waters.

The water quality objectives of this policy are stated in terms of four types of parameters (Bacteriological Quality, Biological Enrichment, Chemical Purity, and Physical Nature.) Each parameter covers a specific aspect of water quality. Together they include all factors necessary to describe the water quality conditions of Lake Tahoe.

Specific indicators were selected to represent each parameter. The indicators were chosen for their ability to detect general changes in water quality, and for their applicability to economical and meaningful surveillance. The selected indicators are the specific water quality objectives and are used in evaluating water quality as it relates to its parameter. Numerical values assigned to each indicator reflect the present water quality conditions and are based upon the most recent data available.

THE WATER QUALITY OBJECTIVES FOR LAKE TAHOE ARE AS FOLLOWS:

### A - BACTERIOLOGICAL QUALITY

#### COLIFORM ORGANISMS

A density not greater than the values shown in the following table:

| Lake Area | Coliform Densities MPN/100 ml | |
|---|---|---|
| | Median | Maximum |
| Undeveloped Lakefront Areas | | |
| 10 yds. offshore | 5 | 32 |
| 100 yds. offshore | 3 | 15 |
| Developed Lakefront Areas | | |
| 10 yds. offshore | 240 | 700 |
| 100 yds. offshore | 15 | 64 |
| Directly Influenced by Stream | | |
| 10 yds. offshore | 240 | 700 |
| 100 yds. offshore | 32 | 240 |

## B - BIOLOGICAL ENRICHMENT

### PLANKTON GROWTH POTENTIAL

A mean annual growth potential at any point in the lake not greater than twice the mean annual growth potential at the limnetic reference station.

### SOLUBLE PHOSPHORUS

A mean annual concentration not greater than 7 micrograms P per liter at any point in the lake.

### TOTAL SOLUBLE NITROGEN

A mean annual concentration of the sum of soluble nitrate-N, nitrite-N, and ammonia-N not greater than 25 micrograms N per liter at any point in the lake.

### PLANKTON COUNT

A mean seasonal concentration not greater than 100 per milliliter and a maximum concentration not greater than 500 per milliliter at any point in the lake.

## C. - CHEMICAL PURITY

### SPECIFIC ELECTRICAL CONDUCTANCE

A mean annual conductance not greater than 95 micromhos per centimeter at 25° C., and a maximum conductance not greater than 105 micromhos per centimeter at 25° C. at any point in the lake.

### CHLORIDE IONS

A mean annual concentration not greater than 3 milligrams per liter, and a maximum concentration not greater than 5 milligrams per liter at any point in the lake.

### DISSOLVED OXYGEN

A concentration greater than 90% of saturation at any point in the lake.

### HYDROGEN ION CONCENTRATION AS pH

a pH within the range of 7.0 to 8.4 at any point in the lake.

## D - PHYSICAL NATURE

### CLARITY

A vertical extinction coefficient less than 0.08 per meter when measured at any depth below the first meter, and a turbidity less than 3 turbidity units at any point in the lake too shallow to determine a reliable extinction coefficient.

### FOREIGN MATERIAL

None which impairs the natural beauty, clarity, or purity of the lake.

### TASTE AND ODOR CAUSING SUBSTANCES

None which imparts foreign taste or odor to the lake waters.

# CHAPTER IV.

## POLICIES FOR THE CONTROL OF WATER QUALITY

The best and most practical method of controlling factors detrimental to water quality are included in this section.

Controls are established regarding methods of waste disposal within the basin. Suggestions are made for controlling development that could result in serious waste disposal problems. Controls are recommended regarding changes in the physical nature of the lake which could result in undesirable water quality in the shoreline areas.

Adherence to these policies will assure to the best of our knowledge the protection of the clarity and purity of the waters of Lake Tahoe.

### A - POLICY REGARDING DISPOSAL OF WASTE WATERS OR OTHER DELETERIOUS MATERIAL TO THE SURFACE WATERS OF THE LAKE TAHOE BASIN

1. There shall be no disposal of treated or untreated domestic sewage, industrial waste, garbage or other solid wastes, or any other deleterious materials, solid, liquid, or gaseous, to the surface waters of the Lake Tahoe Basin.

#### Rationale

The disposal of wastes to the surface waters of the Lake Tahoe Basin must be prohibited as one factor that could rapidly degrade the waters of Lake Tahoe. No method of waste treatment presently feasible removes all the chemical substances related to biological enrichment, and therefore water clarity.

A direct discharge of untreated or insufficiently treated domestic sewage is a health hazard which cannot be tolerated. The waters of Lake Tahoe and its tributaries are used for domestic purposes and other beneficial uses which include bodily contact and consumption by humans.

The Board of Consultants for the Lake Tahoe Area Council (6) made the following statement regarding discharge of treated effluents to the lake waters:

> "An alternative feasible method of disposal is the discharge of treated effluents to the lake waters, through outfalls reaching adequate depths, following special tertiary treatment for removal of both nitrogen and phosphorous. However, the present extent of knowledge, both on methods for removing nitrogen and on effects of nutrients

> on clarity, is meager. This subject is only beginning to be studied on a scientific basis. Within the exception of distillation of the wastes, sufficient technical information is not yet available to permit delineation and design of a practicable nutrient-removing system which will assure protection of the lake. If lake disposal is to be considered, a large-scale experimental program should be undertaken for in situ demonstration of the effectiveness of available processes. Such a program would require from two to three years, and should establish sufficient criteria for the design of works which will assure protection."

### Control

The Legislature has provided in the California Water Code as follows:

Section 13053
Each regional board shall prescribe requirements relative to any particular condition of pollution or nuisance, existing or threatened, in the region.

Section 13054.3
Each regional board, within its region, may specify certain conditions and locations where no direct discharge of sewage or industrial waste will be permitted.

The Lahontan Regional Water Quality Control Board has designated the Lake Tahoe Basin as a location where there is reasonableprobability that direct discharge of sewage or industrial wastes would result in a condition of pollution, and would adversely affect the water quality as it relates to beneficial uses.

This policy will be enforced by the Regional Board.

## B - POLICY REGARDING LAND DISPOSAL OF WASTE WATERS OR OTHER DELETERIOUS MATERIALS WITHIN THE LAKE TAHOE BASIN

The Board encourages and will support State Legislation as well as county and local ordinances which would

1. prohibit or discourage disposal of treated or untreated domestic sewage, industrial waste, garbage or other solid waste, or any other deleterious material onto or into the lands within the Lake Tahoe Basin,

2. prohibit the use of permeable sewage sludge drying beds within the Lake Tahoe Basin,

3. require or promote the export of all waste waters from the Lake Tahoe Basin,

4. require or promote the export of solid waste material such as garbage and dried or burned sewage sludge from the Lake Tahoe Basin,

5. require or promote the planning and development of the Tahoe Basin Sewage Export System (a basin-wide sewerage facility adequate for collection and export of all sewage generated within the Lake Tahoe Basin),

6. require connection to the Tahoe Basin Sewage Export System by all waste dischargers within the basin,

7. prohibit connections to the Tahoe Basin Sewage Export System when it appears that further connections will overload the system,

8. promote the study of waste water treatment methods which could produce an effluent suitable for discharge into the Lake Tahoe Basin without adversely affecting the quality of the waters of the lake.

Rationale

Domestic waste waters, many industrial wastes, and garbage are by nature very high in concentrations of chemical substances which adversely affect water quality. When discharged within the basin, these various chemical substances through percolation find their way to the ground waters and eventually reach the lake.

The Board of Consultants for the Lake Tahoe Area Council (6) made the following statements regarding present methods of waste disposal in the Tahoe Basin:

> "Increasing human activities in the Lake Tahoe Basin and the associated increase in waste production and disposal within the basin, pose a serious threat to maintenance and preservation of the clarity and beauty of the lake waters. The problem primarily stems from the effects on the lake of nutrients, such as nitrogen and phosphorous, which are contained in waste effluents. Even though discharged to the ground, these nutrients ultimately gain access to the lake waters. There is evidence that the clarity of the lake has already been affected by nutrient buildup, and it can be expected that continuation of the present methods of sewage disposal will result in a progressive decrease in clarity and that within a matter of years eutrophication may occur. At this stage the lake waters will support an active population of micro organisms, resulting in loss of clarity and

in the turbid appearance characteristic of most lakes. If the clarity and beauty of the lake are to be preserved, a new concept of waste disposal for the basin must be developed and implemented as soon as possible.

'The seriousness of the situation is illustrated by the fact that the amount of nutrients produced in the basin from human activity is already of the same magnitude as the contribution of nutrients from natural sources, and that anticipated growth will raise the level of nutrients from human activity to many times the natural contribution.

'The present methods of waste disposal practiced within the basin, namely disposal by underground leaching and disposed by hillside spraying, while affording satisfactory public health protection, do not prevent nutrients from reaching the lake. Nutrients leached into the soil travel with ground water and reach the lake with little reduction. Nutrients in effluents sprayed on the ground reach the lake in surface runoff. Deep well injection into porous strata has been suggested; even if such strata were available, this method of disposal would not prevent nutrients from reaching the lake.

'Nutrients reaching the lake tend to become diffused throughout the water mass. Although the lake does not experience seasonal turnovers, thermal diffusion and other mixing processes affect distribution which could lead to mass eutrophication.

'By far the best method for disposing of waste effluents is to remove these from the watershed, . . . "

From these considerations it becomes obvious that with what is known today, all measures which encourage the export of waste materials from the Lake Tahoe Basin are basic to the program of maintaining the present quality of the lake waters.

## Control

The Board will engage in community activities and otherwise stir public awareness to the need for and encourage public support of this policy. The Board will lend support and technical assistance to all programs that implement this policy.

It is the desire and intent of the Board that the various state, county, and local agencies that have legal jurisdiction over matters of this policy, consider and take the necessary action for its support.

## C - POLICY REGARDING DEVELOPMENT ON OR CHANGES OF THE SHORELINE

The Board encourages and will support State Legislation, as well as county and local ordinances which would

1. prohibit construction either by removing, adding, or rearranging materials which by altering the natural shoreline would adversely affect the water quality of Lake Tahoe,
2. require the location and construction of lagoons and marinas separated from but connecting with Lake Tahoe be such that stagnant bodies of water will not be created which would adversely affect the water quality of Lake Tahoe,
3. prohibit construction of piers, docks, breakwaters, cays, or any other structures of such design as to obstruct the natural circulation of the waters of Lake Tahoe.

### Rationale

The natural shoreline of a lake such as Lake Tahoe represents hundreds of thousands of years work by the forces of nature in which the shoreline and shallows are defined to the best advantage of the lake waters. Currents erode materials and deposit them in shallow, still areas. Tributary streams deposit large quantities of material in the marshy areas along the shoreline. These natural forces slowly eliminate areas where circulation is minimal and the natural shoreline becomes that which will allow circulation of all the lake waters.

Man made changes in the shoreline and shallow areas of the lake such as the construction of poorly designed breakwaters and marinas, and the construction of lagoons have resulted in shallow, still, relatively warm waters with insufficient natural circulation to maintain water quality at a high level. The waters in these areas offer ideal conditions for eutrophication. Algae and other plankton flourish, bottom organisms increase in numbers many fold, rocks become covered with slime, weeds grow profusely, and the waters change in color from crystal clear to green and contain large volumes of living organisms and other objectionable suspended matter. These areas act as seed beds and incubators for the remainder of the lake. From time to time, with rising and falling water levels, they are flushed and exchange their highly degraded waters for fresh waters from the lake. The plankton concentration in the lake is increased and clarity decreased.

The lake waters can assimilate some degraded waters, but continued construction of poorly designed marinas, breakwaters, and lagoons may overtax the assimilative capacity of the lake and result in mass eutrophication.

There are at present areas of the lake that support an active population of microorganisms resulting in loss of clarity and a turbid appearance. In light of this fact it becomes obvious that seeding the lake with large volumes of plankton is highly undesirable for it could result in mass eutrophication.

### Control

The Board will engage in community activities and otherwise direct public awareness to the need for and encourage public support of this policy. The Board will lend support and technical assistance to all programs that implement this policy.

It is the desire and intent of the Board that the various state, county, and local agencies that have legal jurisdiction over matters of this policy, consider and take the necessary action for its support.

## D - POLICY REGARDING CONSTRUCTION AND MAINTENANCE PRACTICES IN THE LAKE TAHOE BASIN

The Board encourages and will support State Legislation, as well as county and local ordinances which would

1. require control of drainage during the construction of buildings, subdivisions, roadways, and other projects in a manner that prevents turbid waters from entering the surface waters of the Lake Tahoe Basin,
2. require control of storm runoff from developed areas such as subdivisions, roadways, shopping centers, and parking lots, in a manner that prevents unnatural turbidity in the shoreline areas of Lake Tahoe,
3. require control on the disposal of snow, ice, and street sweepings from roadway maintenance in a manner that prevents turbid or highly mineralized waters from entering the natural surface waters of the Lake Tahoe Basin,
4. limit to a minimum the use of salt on the roadways within the Lake Tahoe Basin.

### Rationale

Turbidity in the shoreline areas of Lake Tahoe is caused largely by construction activities in the watershed. When the natural ground surface in an area is disturbed with heavy construction equipment, large areas of clay, silt, and sand are exposed to the elements. Snow melt and rains carry exposed material into the surface waters tributary to Lake Tahoe. It is both possible and practical to control construction practices in a manner that unnatural turbidity would not be a problem.

Throughout the developed areas of the basin, storm drainage facilities have been constructed with no regard to water quality. Drainage waters carry large quantities of highly turbid waters into the lake, making the beaches and other shoreline areas unattractive. It is impractical to ask for extensive treatment or export of storm waters from developed areas, but it is highly desirable to require proper collection facilities and long submerged outfall storm sewers to minimize the deleterious effects turbid waters have when discharged at the shoreline.

Large quantities of salt are spread upon the roadways of the Lake Tahoe Basin every winter. Salt, being a conservative constituent in water, does not break down or change in character when passing through soil. Nearly 100% of the salt placed upon the roadways eventually enters the lake through ground waters or by direct surface runoff. Uncontrolled use of salt upon the roadways in the basin will increase the salt concentration in the lake waters.

### Control

The Board will engage in community activities and otherwise direct public awareness to the need for and encourage public support of this policy. The Board will lend support and technical assistance to all programs that implement this policy.

It is the desire and intent of the Board that the various state, county, and local agencies that have legal jurisdiction over matters of this policy, consider and take the necessary action for its support.

## E - POLICY REGARDING DISPOSAL OF WASTES FROM BOATS AND MARINAS

1. There shall be no disposal of waste materials from boats or marinas into Lake Tahoe.

The Board encourages and will support State Legislation, as well as county and local ordinances which would

2. require all toilet and galley waste discharge facilities on all boats used in Lake Tahoe be prevented from discharging wastes into the lake waters,

3. require facilities for pumping and adequate disposal of boat wastes at marinas.

31

### Rationale

Contamination and pollution from boats and marinas will, if not controlled, adversely affect the waters of Lake Tahoe for beneficial uses. The potential problem of wastes being discharged from boats near domestic water intakes has been a major concern of both the County and State Health Departments. The sealing of toilet and kitchen waste disposal facilities will offer a constant reminder to boaters and encourage the use of on-shore toilet facilities for disposal of wastes.

### Control

The Board will engage in community activities and otherwise direct public awareness to the need for and encourage public support of this policy. The Board will lend support and technical assistance to all programs that implement this policy.

It is the desire and intent of the Board that the various state, county, and local agencies that have legal jurisdiction over matters of this policy, consider and take the necessary action for its support.

## F - POLICY REGARDING FORESTRY MANAGEMENT IN THE LAKE TAHOE BASIN

1. The Board encourages and will support the activities of the United States Forest Service in their efforts to manage the nutrient balance of the forested areas in the Lake Tahoe Basin.

### Rationale

Forested areas contain a vast reservoir of nutrient materials. With proper forest management this vast reservoir works to the best advantage of the forest in promoting the maximum growth for the available nutrients. Improper management permits large quantities of nutrients to escape from the forested areas and enter ground and surface waters that flow into Lake Tahoe.

Basic to the preservation of the water quality of Lake Tahoe is to limit the nutrient concentration in the lake waters. Proper management of the nutrient balance will work toward the mutual benefit of both the forested areas and the lake waters. Present knowledge on this subject is limited, but the work that has been done indicates that proper management of this nutrient balance plays a most important role in the preservation of the water quality of Lake Tahoe.

## Control

It is the desire of the Board that the United States Forest Service increase its efforts to study the significance of, and the problems associated with, forest management in the Tahoe Basin. The Board is hopeful that the Forest Service will take the necessary action to implement a comprehensive program in the Tahoe Basin.

# CHAPTER V.

## AREA OF APPLICATION OF POLICY *

### A - LOCATION OF STUDY AREA

Figure No. 1 shows the location of Lake Tahoe on the California-Nevada Border, and its relative location to the major cities in the vicinity. Approximately 70 percent of the lake is located in California and 30 percent in Nevada.

The lake's value is largely due to its unique location. It lies within a four-hour drive of some three million people and scarcely more than one day's drive of nearly 10 percent of the total population of the United States.

### B - LAKE TAHOE BASIN

Figure No. 2 outlines the Lake Tahoe Watershed and also the minor watersheds within the basin. The Tahoe Basin has an area of about 506 square miles of which 314 are land and 192 represent the water surface of Lake Tahoe. Over 60 tributary streams carry water into Lake Tahoe. The largest of these is the Upper Truckee River.

The only outlet to the lake is the Truckee River. The flow through this outlet is controlled by a small dam which regulates the top 6.1 feet of the lake, a volume of 720,000 acre feet. The outflows are regulated by the Truckee-Carson Irrigation District to meet the domestic, power generation, and irrigation needs downstream.

### C - DEVELOPED AREA AND LAND USE

Figures No. 3, 4, and 5 show the development in the Lake Tahoe Basin. In 1962 there were about 16,000 permanent residents within the entire Tahoe Basin. During the summer months the population swelled to about 130,000. The population of the entire Tahoe Basin in the year 2010 has been estimated to range between 110,000 during the winter months to a peak summer saturation population of nearly 600,000.

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*Much of this information is from reference No. 3.

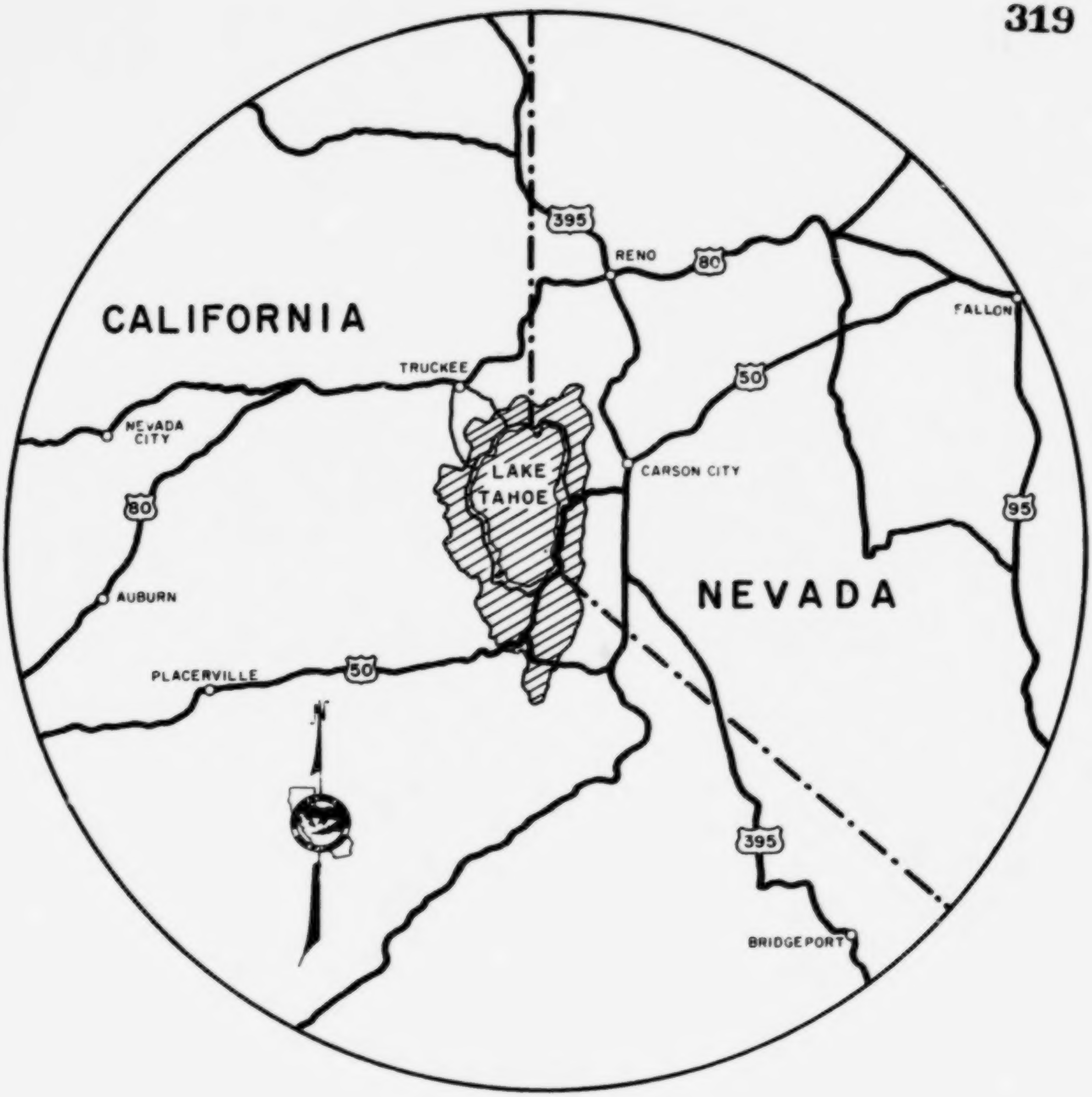

395
RENO
80
CALIFORNIA
FALLON
TRUCKEE
50
NEVADA CITY
LAKE TAHOE
CARSON CITY
80
95
AUBURN
NEVADA
PLACERVILLE
50
N
395
BRIDGEPORT

Figure 1 LOCATION OF AREA

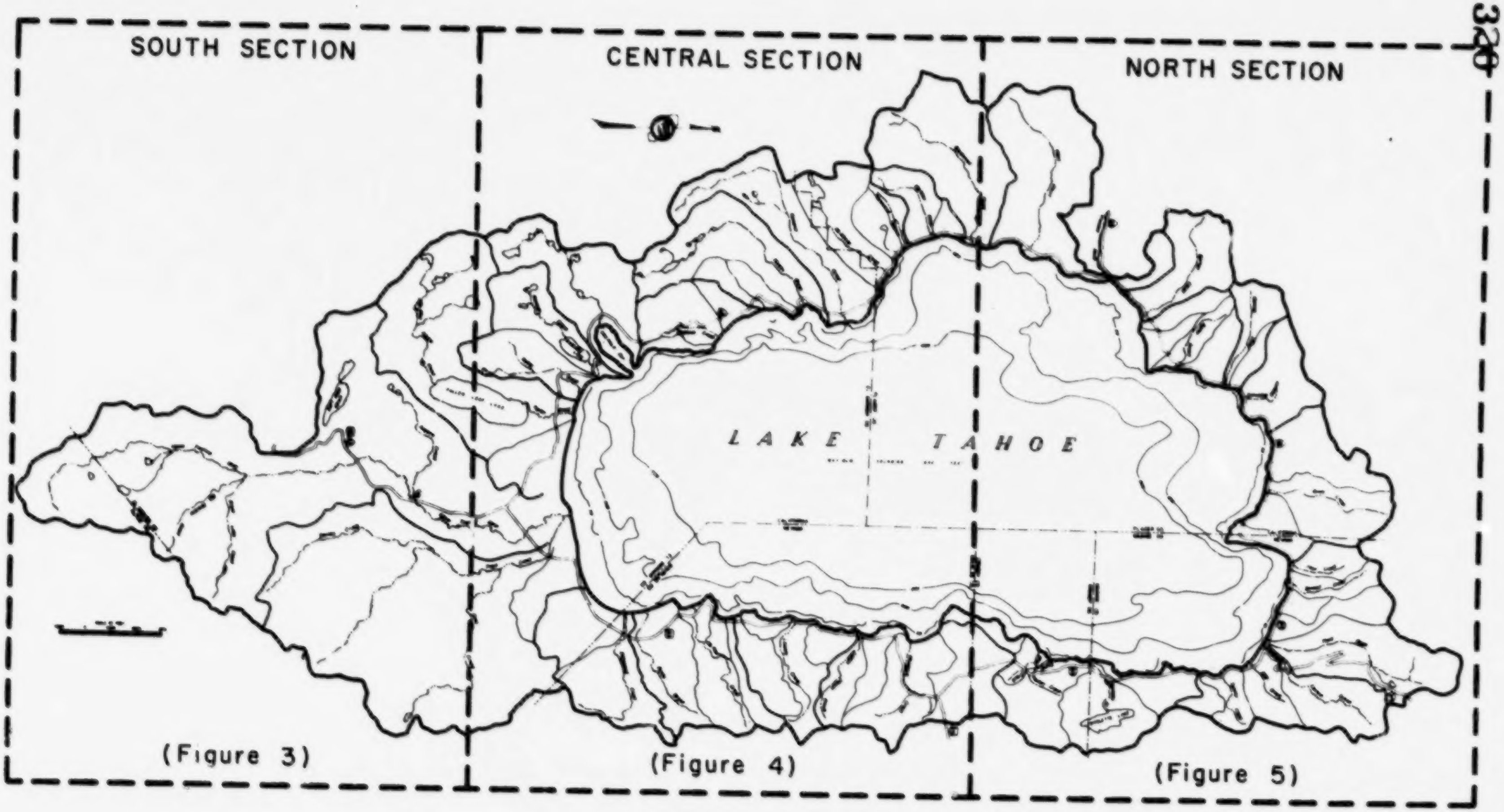

SOUTH SECTION
CENTRAL SECTION
NORTH SECTION
LAKE TAHOE
(Figure 3)
(Figure 4)
(Figure 5)

Figure 2 LAKE TAHOE BASIN

LEGEND

- ☐ RESIDENTIAL & COMERCIAL AREAS
- ▩ AGRICULTURAL AREAS
- ▦ INDUSTRIAL AREAS
- ☐ PARKS & RECREATION, OPEN & SCENIC AREAS

NOTE – THE DEVELOPED AREAS AND LAND USE REFLECT THE STATUS ON MARCH 1, 1966 AS COMPILED FROM THE INFORMATION PROVIDED BY THE FIVE COUNTIES IN THE BASIN

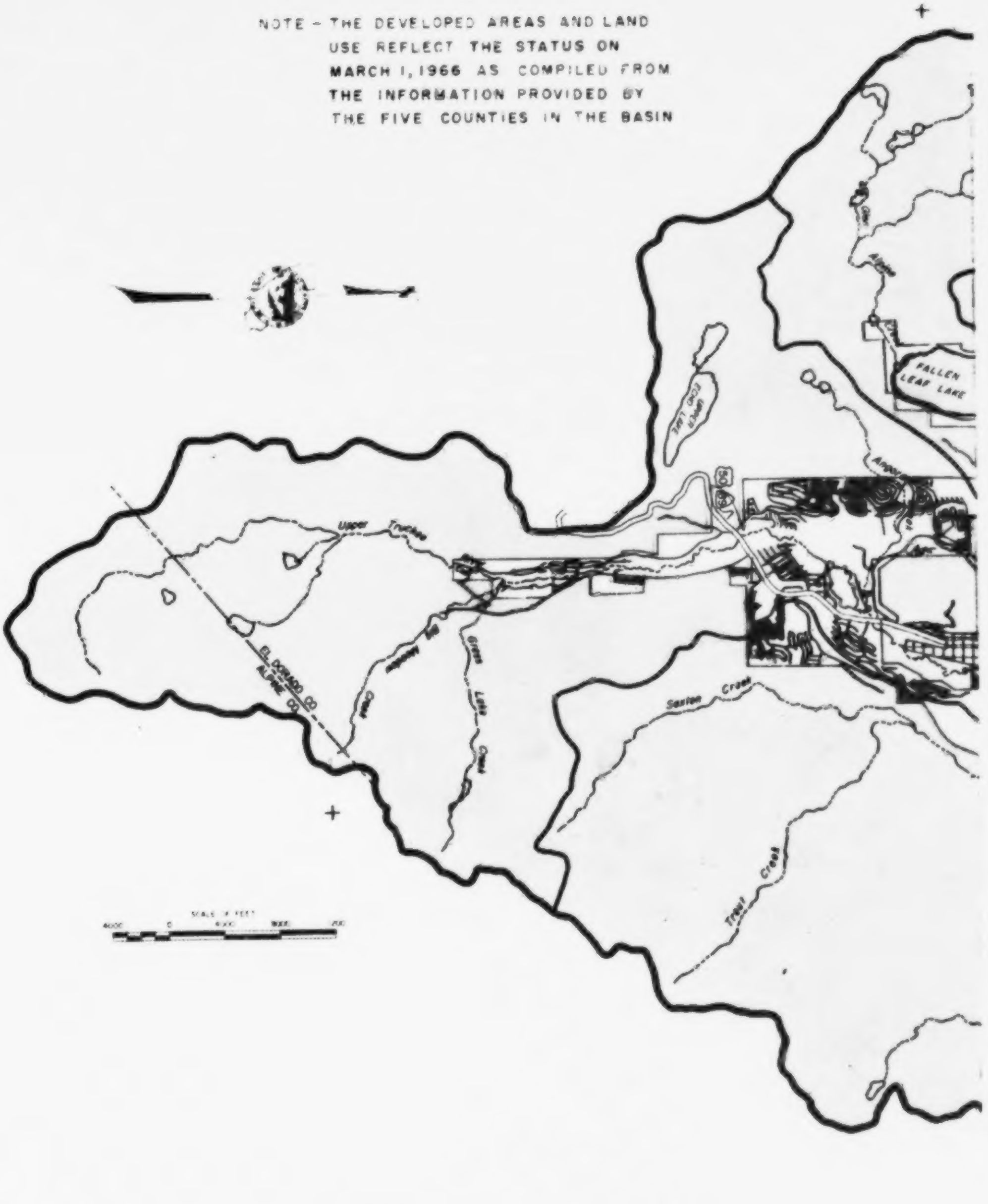

FALLEN LEAF LAKE
UPPER ECHO LAKE
Upper Truckee
Saxton Creek
Trout Creek
Grass Lake Creek
EL DORADO CO
ALPINE CO
50
SCALE IN FEET

Figure 3 SOUTH SECTION

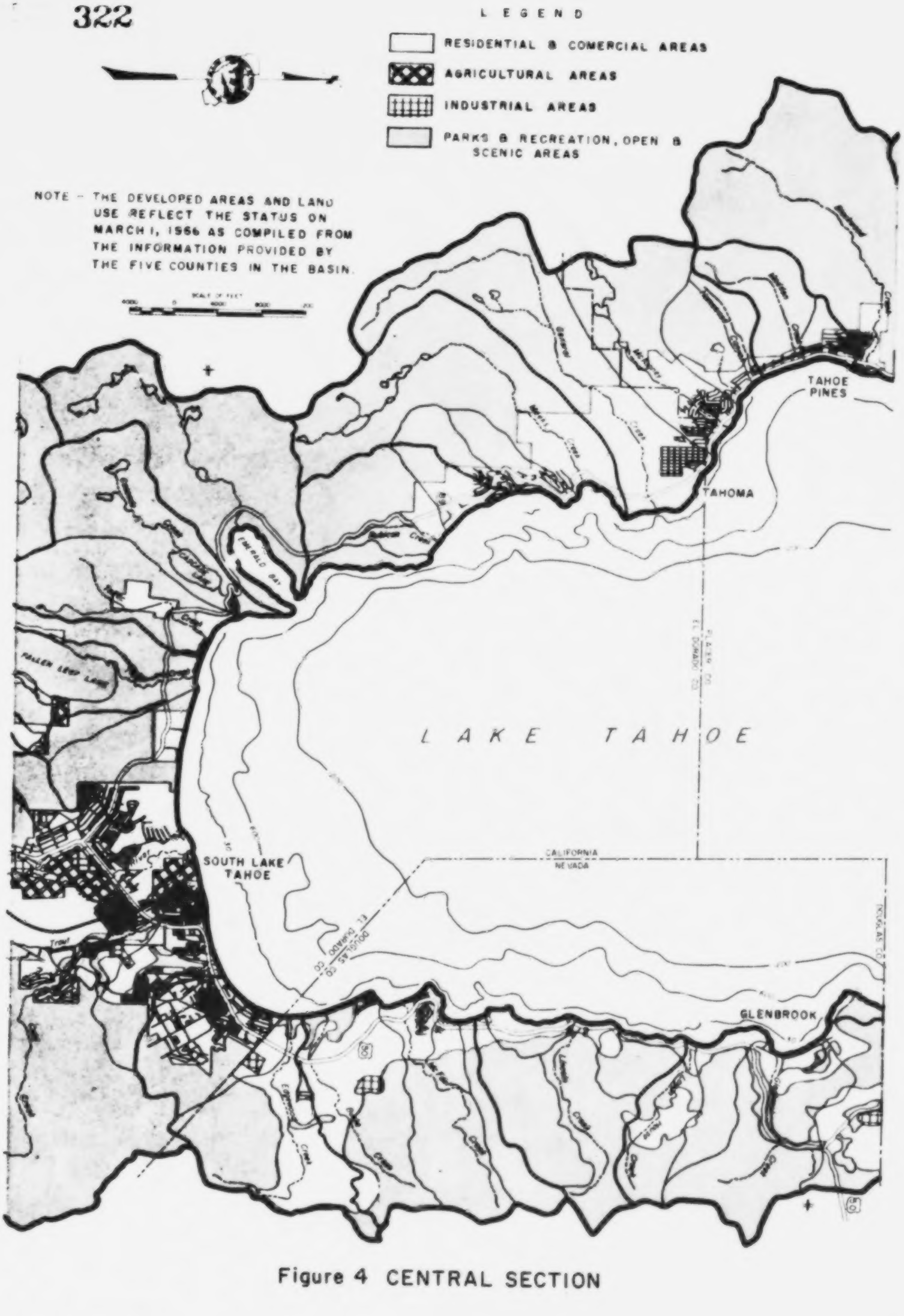
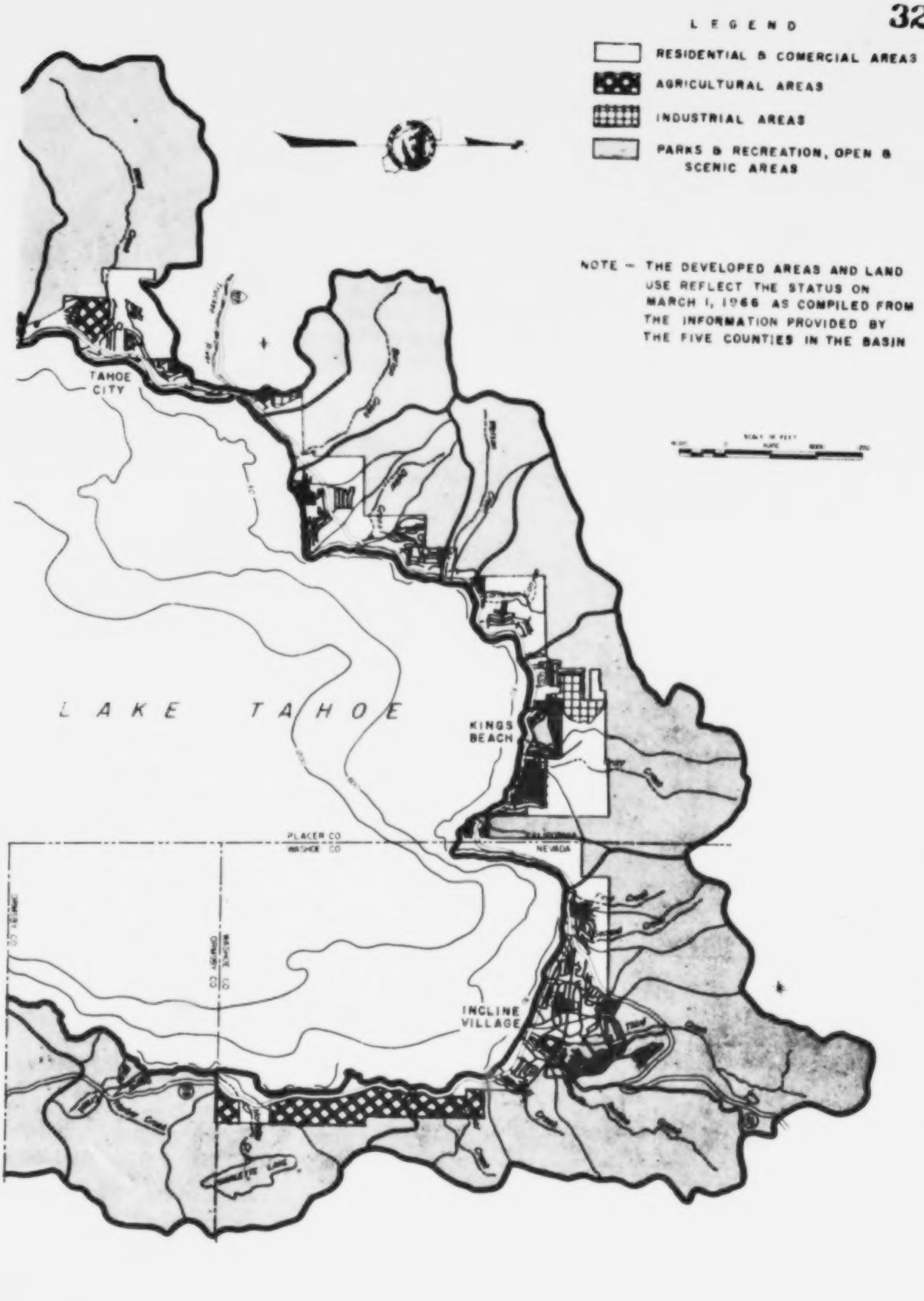

LEGEND
RESIDENTIAL & COMERCIAL AREAS
AGRICULTURAL AREAS
INDUSTRIAL AREAS
PARKS & RECREATION, OPEN & SCENIC AREAS
NOTE - THE DEVELOPED AREAS AND LAND USE REFLECT THE STATUS ON MARCH 1, 1966 AS COMPILED FROM THE INFORMATION PROVIDED BY THE FIVE COUNTIES IN THE BASIN.
SCALE OF FEET
TAHOE PINES
TAHOMA
EMERALD BAY
FALLEN LEAF LAKE
LAKE TAHOE
PLACER CO.
EL DORADO CO.
CALIFORNIA
NEVADA
SOUTH LAKE TAHOE
EL DORADO CO.
DOUGLAS CO.
DOUGLAS CO.
GLENBROOK
50
50

Figure 4 CENTRAL SECTION


LEGEND
RESIDENTIAL & COMERCIAL AREAS
AGRICULTURAL AREAS
INDUSTRIAL AREAS
PARKS & RECREATION, OPEN & SCENIC AREAS
TAHOE CITY
LAKE TAHOE
KINGS BEACH
PLACER CO
WASHOE CO
CALIFORNIA
NEVADA
INCLINE VILLAGE
WASHOE CO
ORMSBY CO

NOTE — THE DEVELOPED AREAS AND LAND USE REFLECT THE STATUS ON MARCH 1, 1966 AS COMPILED FROM THE INFORMATION PROVIDED BY THE FIVE COUNTIES IN THE BASIN

Figure 5 NORTH SECTION

# CHAPTER VI.

## SURVEILLANCE

### A - SAMPLING PROGRAM

To determine compliance with this policy and to monitor the quality of the lake waters, a routine surveillance program will be conducted. Only the work necessary to monitor the lake in regards to this policy will be conducted.

The following represents the minimum surveillance program. Special sampling will be conducted at any time a water quality problem is suspected.

#### SAMPLING SCHEDULE

Samples will be taken, weather permitting, on (or on the first working day after) the following dates:

January 1
March 1
April 1
May 1
June 1
July 1
July 15
August 1
August 15
September 1
November 1

An additional sampling run will be conducted at the time of maximum snow melt and runoff if it is decided that the regularly scheduled dates do not include the major spring runoff.

Additional sampling runs will be conducted if problems of water quality are suspected at times other than regularly scheduled runs.

#### SAMPLING STATIONS

Following is a list of stations to be included in all sampling runs. All sampling stations will be located in areas where the water depth is between 10 and 12 meters unless otherwise specified. The location of the stations is shown on Figure No. 6.

Station No. 1 - Limnetic Reference Station - Midway between Rubicon Bay and Cave Rock

Station No. 2 - Zephyr Cove

Station No. 3 - Glenbrook Bay

Station No. 4 - Crystal Bay off Incline Creek

Station No. 5 - Kings Beach off Snow Creek

Station No. 6 - Tahoe City off Truckee River

Station No. 7 - Blackwood Creek Area

Station No. 8 - Rubicon Bay at Buoy 24

Station No. 9 - Camp Richardson Area

Station No. 10 - South Shore Shelf off mouth of Upper Truckee River, in 5 to 6 meters depth

Station No. 11 - Connelley's Pier

Station No. 12 - Trouble Station - located at point with potential water quality problems

Additional stations will be added if locations are found with water quality problems.

All samples will be collected from immediately below the water surface except for the reference station samples. The reference station samples will be collected from two different depths: One will be taken from immediately below the water surface, the other will be taken from varying depths to determine possible stratification.

## FIELD OR LABORATORY TESTING

The following tests will be conducted in the field at all stations:

Clarity
Dissolved Oxygen
pH
Specific Electrical Conductance
Temperature

The following tests will be conducted in the laboratory with samples collected from all stations:

Chloride Ion Concentration
pH
Plankton Count
Plankton Growth Potential
Soluble Phosphorous
Specific Electrical Conductance
Total Soluble Nitrogen
Turbidity

## COLIFORM SAMPLING SCHEDULE

Coliform Density Surveillance will be conducted during two, one-week periods (one during the time of maximum spring runoff, and one during the time of maximum recreational use.) A portable laboratory will be made available at the lake during these two, one-week periods. To determine compliance with the policy, samples will be collected 10 yards and 100 yards offshore. For general information, samples will be taken at all points considered to be potential problem areas, and at all routine sampling stations.

Additonal sampling (other than the two, one-week periods specified) will be conducted at any time it appears necessary.

## VISUAL APPRAISAL OF CONDITIONS

A photographic aerial survey will be conducted of the shoreline area of the lake twice yearly, (once during maximum spring runoff, and once during late summer.) The purpose of the aerial survey being to photograph all visible sources of degradation to Lake Tahoe, and to pinpoint potential and actual water quality problem areas for further study.

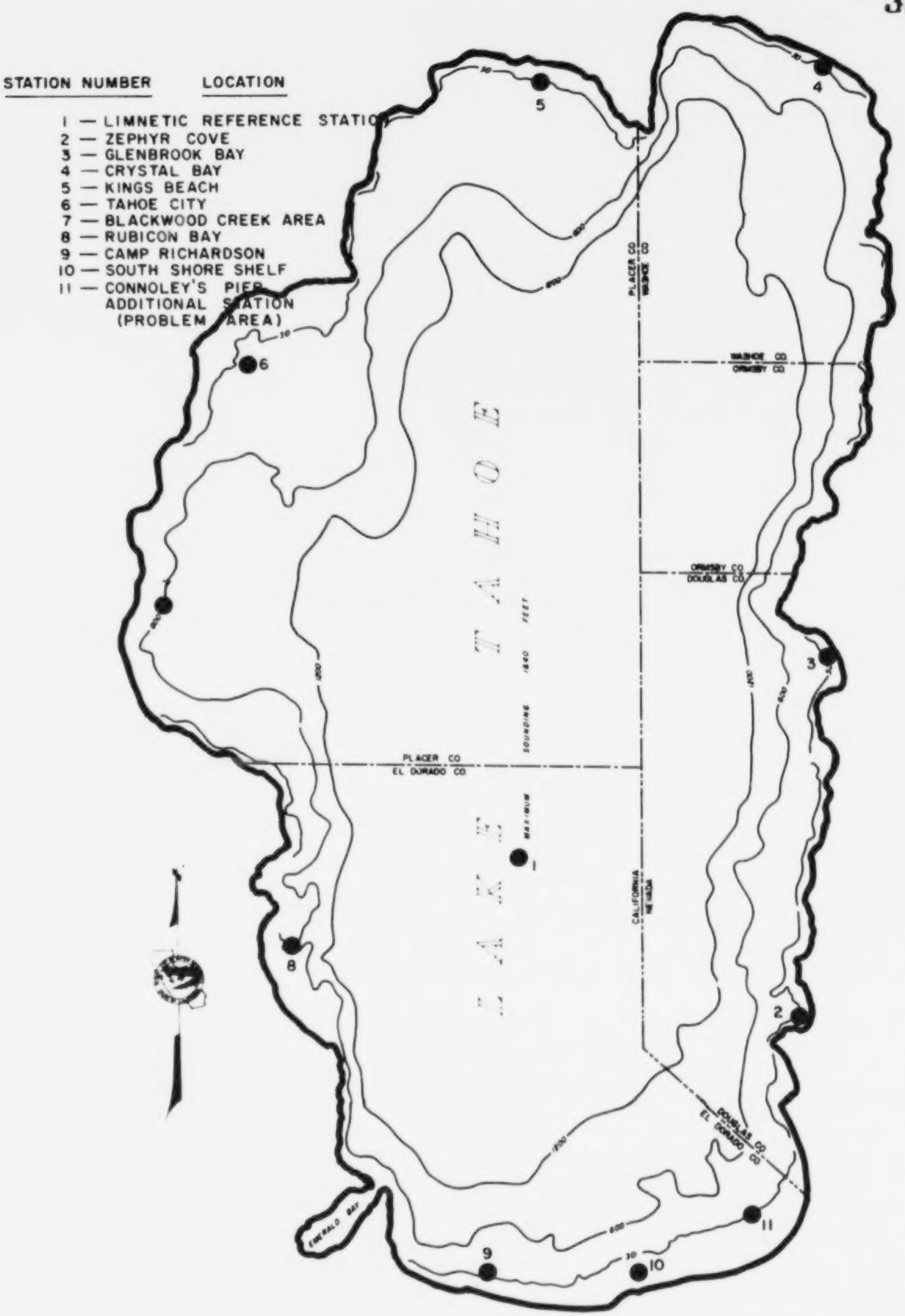

STATION NUMBER
LOCATION
1 — LIMNETIC REFERENCE STATION
2 — ZEPHYR COVE
3 — GLENBROOK BAY
4 — CRYSTAL BAY
5 — KINGS BEACH
6 — TAHOE CITY
7 — BLACKWOOD CREEK AREA
8 — RUBICON BAY
9 — CAMP RICHARDSON
10 — SOUTH SHORE SHELF
11 — CONNOLEY'S PIER
ADDITIONAL STATION
(PROBLEM AREA)
LAKE TAHOE
MAXIMUM SOUNDING 1640 FEET
PLACER CO
WASHOE CO
ORMSBY CO
DOUGLAS CO
EL DORADO CO
CALIFORNIA
NEVADA
EMERALD BAY
30
600
1200
1
2
3
4
5
6
8
9
10
11

Figure 6 SAMPLING STATIONS

## B - SAMPLING, TESTING, AND REPORTING METHODS

### SAMPLING

Routine samples for chemical, biological, and bacteriological analyses will be collected at the appropriate stations from immediately below the water surface. Foreign material such as pollens floating on the water surface will be excluded from the samples.

Samples collected for the analysis of nitrogen and phosphorus will be taken in chemically clean, acid-washed, glass bottles. Samples for chloride, conductivity, dissolved oxygen, pH, and plankton enumeration will be collected in accordance with Standard Methods (7). Samples for plankton growth potential will be taken in chemically clean, acid-washed, glass bottles. Chromate salts will not be used in acids for washing glassware.

Analysis of all samples will be initiated as promptly as possible. If the determination of nitrogen and phosphorus cannot be undertaken within 12 hours, the samples can be preserved best by freezing at -20° C. Samples collected for plankton enumeration, if not examined within 24 hours of collection, will be preserved with 160 ml formalin per gallon and stored in the dark. Information on the effect of sample storage on the plankton growth potential is not available. Analytical delays of 24-48 hours are unlikely to be significant if the sample is refrigerated and stored in the dark. Bacteriological samples cannot be preserved and will be analyzed within 24 hours.

### TESTING

Chloride: Standard Methods (7), Page 87 Mercuric Nitrate Method. The mercuric nitrate titrant should be prepared so that 1.0 ml = 0.20 mg Cl and a microburet should be used for the titration.

Clarity: The light penetration will be measured by using two identical hydrophotometers (photo electric cells.) These cells will have been measured with care at the factory to ensure equal readings under identical light conditions. One cell will be used as a deck cell to measure the amount of incident light striking the water surface. This deck cell will be referred to at the time readings are taken from the submerged cell, to correct for changing light conditions.

The submerged cell will be initially read in air, slightly above the water surface, and then submerged. Readings will be obtained at one meter intervals for the first 10 meters of depth. If necessary, readings will be obtained from greater depths at 5 meter intervals until the desired depth is reached. All readings will be corrected to a percentage of surface light by comparison against the light value obtained from the deck cell at the time of each submerged reading. The percentage of light transmitted to each point in depth shall be plotted on semi-log paper. The ordinate and abscissa, respectively, will be the percentage of light transmitted, and the depth in meters. A smooth curve of best-fit will be drawn through the points and the slope of the line, the extinction coefficient determined.

Coliform Bacteria: Standard Methods (7), Page 594 for multiple tube fermentation technique, or Page 610 for the membrane filter technique. If the multiple tube fermentation technique is used the portions planted should be at least 5-10 ml portions, 2-1.0 ml portions, and 2-0.1 ml portions.

Conductivity: Standard Methods (7), Page 280.

Dissolved Oxygen: Standard Methods (7), Page 406, Azide Modification of Iodometric Method. In calculating percent saturation corrections for pressure (elevation) must be used.

Nitrogen: Total soluble inorganic nitrogen shall consist of the sum of nitrate, nitrite, and ammonium nitrogen in a sample filtered through a 0.45 micron membrane filter. The procedures should be from A Manual of Sea Water Analysis, Strickland, J.D.H. and Parsons T.R. (8). Statistical reliability of these methods has not been confirmed. During the first year of the surveillance program the analytical laboratory should verify the claims for precision and accuracy made by the authors.
Nitrate and Nitrite: Strickland and Parsons (8), Pages 73-78.
Ammonia: Strickland and Parsons (8), Pages 83-87.

pH: Standard Methods (7), Page 226 Glass Electrode Method.

Phosphorus: Soluble phosphorus shall be the inorganic phosphorus in a sample filtered through a 0.45 micron membrane filter. It has also been referred to as soluble reactive phosphorus or soluble inorganic phosphate. Statistical reliability of this method has not been confirmed. During the first year of the surveillance program the analytical laboratory should verify the claims for precision and accuracy made by the authors.
Soluble Phosphorus: Strickland and Parsons (8), Pages 47-51.

Plankton Count: Standard Methods (7), Page 660 Continuous Centrifuge Method for Estimation of Total Plankton. The plankton identification scheme of the National Water Quality Network (9), which is based on major taxonomic groupings and organism morphology within the major groupings is convenient. Dominant organisms should be identified to genus, and if possible, to species.

Plankton Growth Potential: A detailed published procedure for making this analysis is not available. Skulberg (10), provides the best available reference. In this procedure, filtered water samples are inoculated with an appropriate uni-algal culture (preferably a culture of a species which is dominant in the receiving water) and incubated under controlled conditions of lighting, temperature, and agitation. Provisionally, lighting is set at 6000 lux at the surface on which the culture flask rests, temperature set at 20° C., and agitation provided by a reciprocal shaking machine. Periodic cell counts up to about 14 days will define growth rates and maximum cell numbers. The results obtained from any test sample will be compared with the results from a sample collected from the reference station which is simultaneously analyzed.

Since neither the procedures nor the statistical reliability of this procedure have been studied in detail, the analytical laboratory should investigate this procedure during the first year of the surveillance program and establish a standardized technique.

Turbidity: In the littoral area of the lake, or more specifically in areas too shallow to determine a reliable extinction coefficient with a photometer, the Hach CR Low Range Turbidimeter will be used with the appropriate filters or apertures necessary to provide an accurate reading in the low ranges.

## REPORTING

The analytical laboratory will report results promptly. Reporting units will be as follows:

Chloride - mg/l

Clarity - Vertical extinction coefficient

Coliform Bacteria - Most probable number per 100 ml or membrane filter count per 100 ml

Conductivity - Micromhos/cm at 25° C

Dissolved Oxygen - mg/l and percent saturation

Nitrogen - Micrograms N/l

pH - pH units to 0.1 unit

Phosphorus - Micrograms P/l

Plankton Count - Total plankton count, cells/l and grouped count, cells/l

Plankton Growth Potential - Growth rate as shown graphically or by derivation of the expression for the logarithmic growth phase; maximum cell number, cells/ml and the ratio of cells/ml test station to cells/ml reference station

Turbidity - Turbidity units to 0.1 unit

## C - EVALUATION OF RESULTS

In evaluating laboratory and field results the objective of this policy, to maintain the water quality of the lake at its present natural condition, will be of prime concern. Upon receiving a sample that indicates a water quality objective has been violated, intensive sampling will be conducted in the vicinity of the suspected station. If the results of the intensive sampling show that the water quality objective is being violated, that is, the water quality in an area of the lake has in fact degraded below the objective, immediate steps will be taken to determine the cause and afford a solution.

As data become available it will be evaluated to determine its statistical variation. A log-probability plot will be made of each indicator at each station. This will establish a firm, statistically sound basis for defining the water quality at each station.

Because a primary use of surveillance is to detect changes before they become objectionable, the proper statistical evaluation of the data will, by defining conditions at each station, form a sound basis for evaluation of water quality changes with time. After present conditions are adequately defined, they will become the basis for determining compliance with the policy because the objective of this policy does not permit adverse change in water quality. Results of analyses will be compared to the results obtained previously. Upon receiving a sample, or series of samples, that statistically show the water quality at a station is adversely changing, immediate steps will be taken to determine the cause and afford a solution to the problem.

# CHAPTER VII.

## EXPLANATION OF WATER QUALITY OBJECTIVES

An explanation of the general rationale used in choosing the types of parameters, the specific indicators, and the values, is given in detail as the Introduction to Chapter III., "Water Quality Objectives."

Although much information is available on the present water quality of Lake Tahoe, very little data have been gathered that could be subjected to a statistical evaluation meaningful to the purpose of establishing objectives. As a result, rather than the preferable method of stating objectives or standards wherein the statistical variation or distribution is specified, the objectives are stated in the method which appeared to best reflect the value of available data in describing present conditions.

Keeping in mind the prime objective of this policy, maintaining present water quality conditions, and the fact that the only proper method of defining present conditions is to define in the objective the statistical variation or distribution of data, the results collected during the initial year of surveillance will be analyzed on a statistical basis. Chapter VI., Section C, "Evaluation of Results," explains more fully the rationale and intent of surveillance as related to this policy.

The methods by which the objectives are stated, and the parameters, indicators, and values chosen are therefore tentative and will be revised when data becomes available that allows the objectives to be stated in a statistically sound method defining the variation or distribution that more precisely and meaningfully describes present conditions.

### A - BACTERIOLOGICAL QUALITY

The policy of both the States of Nevada and California and of local agencies has been that sewage and industrial waste shall not be allowed to enter Lake Tahoe or its tributary streams. The fact that bacteriological objectives are herein stated is not to be considered an implication of change in this policy. Sewage or industrial wastes, regardless of the degree of treatment, are to be excluded from the lake or its tributary streams.

The bacteriological objectives established are to be used as one of the indices of man's activities on the Lake Tahoe watershed, and as an indicator of impairment of the lake's water quality by wastes or other factors.

## COLIFORM ORGANISMS

When sewage is discharged into surface waters, large increases in the densities of coliform organisms result. Also, when construction activities such as the building of roads and bridges, and the dredging of canals are done in a careless manner which allows larger quantities of disturbed soil to be carried into surface waters, higher coliform concentrations result. The high concentrations result from the introduction into waters of natural soil organisms of the coliform group. In addition, drainage from areas used for the disposal of organic refuse, from lawns fertilized with animal manure, and from pastures and stables where horses or cattle are kept, will cause high coliform densities in receiving waters.

The objectives establish limits for densities of coliform bacteria. The coliform group of organisms as a significant parameter of the sanitary quality of water has long been used. Large numbers of organisms of the coliform group of bacteria are found in domestic sewage since they have their origin in the intestinal tract of man. However, the organisms are also found in soil and in water which has been subject to pollution by dust, insects, birds, animals and surface drainage. The use of "fecal coliform" bacteria, fecal streptococci and total plate count numbers were also considered for use as objectives. They were not included at this time, however, because of the complete lack of background data for Lake Tahoe upon which baselines might be established. Also, the laboratory techniques for determining the densities of these organisms have only recently been standardized.

The only comprehensive study of the bacteriological quality of Lake Tahoe was done by the California State Department of Public Health during the summer of 1961 (2). This study was confined to the California portion of the lake. The other sampling programs have involved only limited numbers of samples per month or have been special studies of potential sewage contamination in small areas of the lake.

During the summer of 1961, sanitary surveys were made of all Lake Tahoe watershed areas in California in which septic tanks were used for sewage disposal. In four instances, failures of leaching systems were found; however, none of these were overflowing into Lake Tahoe. Sewage from community systems was confined to the proper land disposal areas; there was no overflow or runoff to the lake or its tributaries. During the summer of 1961 no evidence was found from the many tests for detergents, chlorides, phosphates, nitrates, and bacteria that sewage was reaching the waters of Lake Tahoe. The bacterial densities in the lake in 1961 are considered to be "background" densities; that is, they represent the effects of activities other than sewage disposal on the bacterial quality of Lake Tahoe. Therefore, the bacterial densities found during the 1961 survey are the basis upon which the objectives for Lake Tahoe were selected.

The values were selected for three types of areas: 1) Undeveloped Lakefront Areas; 2) Developed Lakefront Areas; 3) Areas Influenced by Streams. For each type of area, a value for 10 yards offshore and 100 yards offshore was selected. The 10 yards offshore value will be used for special sampling programs at beaches, marinas, piers, and mouths of streams. In these areas, local activity influences water quality. The 100 yards offshore values will be used to determine the general bacteriological quality of the lake waters.

The 1961 study was divided into an Early Summer Phase and a Late Summer Phase, during which a total of 1,139 coliform MPN (Most Probable Number) determinations were made of Lake Tahoe waters. The lake sampling stations were chosen as follows: 1) at popular beaches; 2) at areas where there was considerable development and boating activities; 3) over public water supply intakes; and 4) at the mouths of major streams tributary to the lake. With the exception of special beach and marina sampling, most samples were taken from 50 to 100 yards offshore. Special studies were also made to determine the variations of coliform bacteria concentration with depth and distance offshore.

In general, it was found that higher levels of coliform bacteria were found in lake waters influenced by streams, swimming, and boating. Coliform bacteria densities decreased as the depth increased, and at 30-foot depths, few coliform bacteria were recovered. Near the six community water supply intakes studied, the coliform densities at surface and bottom were very low. The highest coliform densities were found along the south shore of Lake Tahoe during the early summer phase due primarily to high coliform concentrations in the Truckee River and Bijou Creek. Coliform densities along the Tahoe south shore were much lower during the late summer phase when the flows of both the Upper Truckee River and Bijou Creek had diminished.

A summary of the 1961 bacteriological analyses of surface samples is shown in Table 2. Each station has been coded according to use. The special beach and marina sample results were separated from the 50 to 100 yards offshore results. The samples taken at the beaches and marinas in the developed lakefront areas had considerably higher coliform densities than samples taken 50 to 100 yards offshore.

The median and maximum coliform densities (MPN/100 ml) found in the 50 to 100 yards offshore areas are given in Tables 3 and 4. The median and maximum coliform densities found at beaches and marinas are given in Table 5. The bacterial objectives selected for these lake areas are also shown in the tables for comparison.

## Table 2

## SUMMARY OF BACTERIOLOGICAL RESULTS FROM SURFACE SAMPLES

| ** | * | | 50 TO 100 YDS. OFFSHORE | | SAMPLED FROM SHORE | | |
|---|---|---|---|---|---|---|---|
| | | | COLIFORM MPN/100 ml | | | COLIFORM MPN/100 ml | |
| STATION | USE | NO. SAMPLES | Range | Median | NO. SAMPLES | Range | Median |
| 1 | B | 9 | L2 - 6 | 4.6 | 2 | 23 - 230 | 23 - 230 |
| 2 | S | 10 | L4.5 - 23 | 8.8 | 1 | 23 | 23 |
| 3 | LU | 9 | L4.5 - 50 | 6 | - | - | - |
| 4 | B | 9 | L4.5 - 8.8 | 4.4 | - | - | - |
| 5 | M | 9 | L2 - 38 | 5 | - | - | - |
| 6 | I | 7 | L4.5 - 21 | 2.2 | - | - | - |
| 7 | LU | 9 | L4.5 - 15 | L4.5 | - | - | - |
| 8 | P | 8 | L4.5 - 23 | 5 | - | - | - |
| 9 | P | 11 | L2 - 8.8 | L4.5 | 1 | L4.5 | L4.5 |
| 10 | B | 11 | L4.5 - 38 | L4.5 | - | - | - |
| 11 | M | | | | 12 | L4.5 - 240 | L4.5 |
| 12 | B | 12 | L2 - 8.8 | 2.2 | - | - | - |
| 13 | LU | 8 | L2 - 2.2 | L4.5 | - | - | - |
| 13-½ | C | 6 | L2 - L4.5 | L4.5 | - | - | - |
| 14 | P | 10 | L4.5 - 5 | L4.5 | - | - | - |
| 15 | B | 7 | L2 - 38 | L4.5 | - | - | - |
| 16 | B | 9 | L2 - 6 | 5 | - | - | - |
| 17 | B | 8 | L2 - 6 | L4.5 | - | - | - |
| 18 | B | 7 | L4.5 - 38 | 5 | - | - | - |
| 19 | B | 9 | L2 - 8.8 | 2.2 | - | - | - |
| 20 | P | 13 | L2 - 62 | 2.2 | 1 | L4.5 | L4.5 |
| 21 | B | 12 | L2 - 23 | L4.5 | - | - | - |
| 22 | B | 10 | L2 - 23 | L4.5 | - | - | - |
| 23 | M | 14 | 4.5 -7,000<br>(raining) | 6 | 1 | 7,000 | 7,000<br>(TahoeKeys) |
| 24 | S | 13 | L4.5 - 240 | 6 | - | - | - |
| 25 | S | 8 | L4.5 -G240 | 2.2 - 23 | - | - | - |
| 26 | S | 8 | L4.5 -G240 | L4.5 - 7.5 | - | - | - |
| 27 | B | 11 | L4.5 - 240 | 6 | 1 | 62 | 62 |
| 28 | B | 11 | L4.5 - 62 | 8.8 | 1 | 7,000 | 7,000 |
| 29 | B | 11 | L4.5 - 23 | 4.6 | - | - | - |
| 30 | P | 3 | 6 - 38 | 21 | 1 | 6 | 6 |
| 31 | I | 7 | L4.5 - 15 | L4.5 | - | - | - |
| 32 | S | 11 | L4.5 -G240 | 6 | - | - | - |
| 33 | B | 9 | L4.5 -G240 | 4.6 | - | - | - |
| 34 | P | 6 | L4.5 - 62 | 6 | - | - | - |
| 35 | M | 9 | | | 9 | L4.5 - 7,240 | 23 |
| 36 | B | 9 | L4.5 - 38 | 13 | - | - | - |

Table 2 (Continued)

| ** STATION | * USE | NO. SAMPLES | 50 TO 100 YDS. OFFSHORE COLIFORM MPN/100 ml Range | Median | SAMPLED FROM SHORE NO. SAMPLES | COLIFORM MPN/100 ml Range | Median |
|---|---|---|---|---|---|---|---|
| 50 | LU | 9 | L2 - 8.8 | 2.2 | - | - | - |
| 50-½ | B | 2 | L4.5 - 6 | L4.5 - 6 | 4 | L4.5 - 23 | 6 - 23 |
| 51 | B | 10 | L4.5 - 38 | 21 | 3 | L4.5 - 62 | 6 |
| 51-B | I | 4 | L2 - 38 | L4.5 - 5 | - | - | - |
| 52 | LU | 9 | L2 - 8.8 | 2.2 | 4 | L4.5 - 62 | L4.5 - 4.6 |
| 52-½ | B | 4 | L4.5 - 15 | 2.2 - 5 | 5 | 23 -2,400 | 62 |
| 53 | I | 10 | L2 - 5 | 2.2 | 6 | L4.5 -7,000 | 6 |
| 54 | LU | 8 | L2 - 38 | L2 | - | - | - |
| 55 | M | 9 | L2 - 6 | L2 | 4 | 4.6 - 62 | 6 |
| 56 | S | 7 | L2 - 15 | 2.2 | 1 | 6 | 6 |
| 57 | LU | 8 | L2 - 38 | 4.5 | - | - | - |
| 58 | LU | 8 | L2 - 62 | 2.2 | - | - | - |
| 59 | I | 8 | L2 - 6 | L2 | - | - | - |
| 60 | P | 8 | L2 - 6 | L4.5 | 4 | 62 - 620 | 62 - 230 |
| 61 | P | 9 | L2 - 23 | L4.5 | 4 | L4.5 - 62 | L4.5 - 23 |
| 62 | M | 9 | L2 - 5 | L4.5 | 4 | 6 - 62 | 62 |
| 63 | I | 10 | L2 - 23 | L4.5 | - | - | - |
| 64 | O | 9 | L2 - 2.2 | L4.5 | 4 | 21 - 62 | 23 |
| 65 | P | 11 | L2 - 23 | L4.5 | 1 | 230 | 230 |
| 66 | M | 11 | L2 - 6 | L4.5 | 4 | 13 -- 62 | 23 - 62 |
| 67 | S | 10 | L2 - 15 | L4.5 | - | - | - |
| 68 | B | 10 | L2 - 6 | L4.5 | 6 | L4.5 -2,400 | 6 - 23 |
| 69 | S | 10 | L2 - 15 | L2.2 - 5 | 2 | 6 - 23 | 6 - 23 |
| 70 | S | 8 | L2 - 21 | L2 - 2.2 | 1 | 62 | 62 |
| 71 | M | 10 | L2 - 240 | L4.5 - 5 | 6 | L4.5 - 230 | L4.5 - 6 |

LEGEND

| *Use Symbol | Description |
|---|---|
| I | Sampled over the mouth of intakes |
| LU | Areas of little use 50 to 100 yards offshore |
| P | Areas in vicinity of piers and boat ramps |
| M | Areas near marinas |
| B | Areas near beaches |
| S | Areas near mouth of streams |
| O | Lake outlet at Tahoe City |
| C | Control station - 2 miles off Rubicon Point |

**See reference No. 4 for description of stations

L - Less than
G - Greater than

## Table 3

### MEDIAN COLIFORM DENSITIES FOUND AT OFFSHORE AREAS
### SURFACE SAMPLES 50 TO 100 YARDS OFFSHORE
### MPN/100 ml

| AREA | NO. OF STATIONS | NO. OF SAMPLES | RANGE OF MEDIANS** | OBJECTIVES* CHOSEN | REMARKS |
|---|---|---|---|---|---|
| Intakes | 6 | 46 | L2 - 5 | - | - |
| Little Use | 8 | 68 | L2 - 6 | 3 | One station exceeded objectives. |
| Piers | 10 | 79 | L4.5- 21 | 15 | One station exceeded objectives. |
| Marinas | 7 | 71 | L4.5- 6 | 15 | All stations met objectives. |
| Beaches | 20 | 160 | L4.5- 21 | 15 | One station exceeded objectives. |
| Off Mouth of Streams | 9 | 85 | L4.5- 8.8 | 32 | Objectives higher than median values because of high densities during spring runoff. |

## Table 4

### MAXIMUM COLIFORM DENSITIES FOUND AT OFFSHORE AREAS
### SURFACE SAMPLES 50 TO 100 YARDS OFFSHORE
### MPN/100 ml

| AREA | NO. OF STATIONS | NO. OF SAMPLES | RANGE OF MAXIMUMS*** | OBJECTIVES* CHOSEN | REMARKS |
|---|---|---|---|---|---|
| Intakes | 6 | 46 | 6 - 38 | - | - |
| Little Use | 8 | 68 | 2.2- 62 | 32 | Two stations had a total of 3 samples exceeding objectives. |
| Piers | 10 | 79 | 6 - 62 | 64 | All stations met objectives. |
| Marinas | 9 | 71 | 5 - 7,000 | 64 | Two stations had a total of 5 samples exceeding objectives. |
| Beaches | 20 | 160 | 6 - G240 | 64 | Two stations had one sample exceeding objectives. |
| Off Mouth of Streams | 9 | 85 | 15 - G240 | 240 | Two stations had one sample exceeding objectives. |

* Objectives are for 100 yards offshore.
** Range of medians for each station.
*** Range of maximums for each station

L -Less than
G -Greater than

## Table 5

### MEDIAN AND MAXIMUM COLIFORM DENSITIES FOUND AT BEACHES AND MARINAS MPN/100 ml

| LOCATION | NO. SAMPLES | RANGE | MEDIAN | REMARKS |
|---|---|---|---|---|
| Stateline Beach* | 14 | 4.6 - 4,300 | 62 | One sample exceeded maximum limit. |
| South Shore-East Beach* | 14 | 13 - 700 | 230 | Objectives met by all samples. |
| Marina-West Beach* | 14 | L4.5 - 620 | 230 | Objectives met by all samples. |
| Surf & Sand Marina* | 14 | 6 - 620 | 230 | Objectives met by all samples. |
| El Dorado Co. Beach* | 14 | 4.6 - 620 | 146 | Objectives met by all samples. |
| Globin Beach* | 14 | 9.2 - 2,300 | 230 | One sample exceeded maximum limit. |
| Richardson Beach | 14 | 6 - 2,300 | 62 | One sample exceeded maximum limit. |
| Brockway Pines Beach | 4 | L4.5 - 23 | 6 -23 | Objectives met by all samples. |
| Kings Beach Pier | 5 | 23 - 2,400 | 62 | One sample exceeded maximum limit. |
| Town & Country Beach | 6 | L4.5 - 2,400 | 6 -23 | One sample exceeded maximum limit. |
| Chambers Lodge Beach | 2 | 23 - 230 | 23 -230 | Objectives met. |
| Globin Pier | 1 | 62 | | Objectives met. |
| El Dorado Beach | 1 | 7,000 | 7,000 | Single sample exceeded maximum limit. |
| Sierra Boat Co. Marina | 4 | 4.6 - 62 | 6 | Objectives met by all samples. |
| Tahoe City Marina | 4 | 6 - 62 | 62 | Objectives met by all samples. |
| Sunnyside Marina | 4 | 13 - 62 | 23 -62 | Objectives met by all samples. |
| Obexner's Marina | 6 | L2.5 - 230 | L4.5 - 6 | Objectives met by all samples. |
| Meeks Bay Marina | 12 | L4.5 - 240 | L4.5 | Objectives met by all samples. |
| Tahoe Keys | 1 | 7,000 | 7,000 | Single sample exceeded maximum limits. |
| Lakeside Marina at Entrance | 9 | L4.5 - G240 | 23 | Objectives met by all samples. |

*Special Beach Study - Samples taken in 2-foot-deep water.

Objectives: Median 240 MPN/100 ml
Maximum 700 MPN/100 ml

L-Less than
G-Greater than

## B - BIOLOGICAL ENRICHMENT

The blue color and extreme clarity of Lake Tahoe are attributes which these water quality objectives are meant to preserve. Both of these may be grossly affected by the growth of organisms, particularly plankton. Plankton blooms can result in green discoloration of the water and by the increase in suspended materials markedly decrease light transmittance. A large number of factors may be involved in the development of plankton blooms: Physical factors such as light and temperature are important, but possibly more important to Lake Tahoe are chemical factors which have been generally termed nutrients, that is, chemical substances that are essential metabolites for the algae which are the principal plankton forms. Among the nutrients, nitrogen and phosphorus are best understood, however, such elements as iron, silica, potassium, calcium, sulfur, etc., may be equally important. Organic growth factors such as vitamins also play an important roll.

### PLANKTON GROWTH POTENTIAL

Since it is impossible to predict the development of phyto-plankton solely on the basis of the concentrations of nitrogen and phosphorus in the water, efforts have been directed toward a more generalized analytical procedure for the estimation of the growth supporting potential of water. In its simplest form such a test would consist of the exposure of water samples in a window within the laboratory. Over a period of time the growth of algae would be observed and conclusions might be drawn as to the potential for support of algal growth possessed by the sample. Oswald and Goleuke (11) and Skulberg (10) have refined and made this technique quantitative although neither has described what might be termed a standard method.

In defining the plankton growth potential water quality objective for Lake Tahoe there are two difficulties: 1) As indicated above, a detailed or standardized measurement technique is unavailable; and 2) data on the plankton growth potential of Lake Tahoe or its tributary waters are very limited. Although work to relieve both limitations is underway, the stated water quality objective can be considered only as provisional. The rationale of the objective is valid since the aim is to exclude those substances from the lake which would stimulate plankton growth in comparison to the plankton growth of the reference station.

### SOLUBLE PHOSPHORUS

Data on the effect of soluble phosphorus on plankton growth have been summarized in the report on the Lake Tahoe Basin (6). There seems to be a consensus that at a phosphate-phosphorus concentration of not more than 10 micrograms P/liter, plankton blooms are unlikely to occur. Data presented in this report (6) showed an average concentration of phosphate as 7 micrograms P/liter with a maximum of 25 micrograms P/liter from a bottom sample.

On the basis of available information it appears reasonable to set as the objective the mean annual concentration of soluble phosphorus not to exceed 7 micrograms P per liter.

## TOTAL SOLUBLE NITROGEN

Data on the effect of inorganic forms of nitrogen, largely as nitrates, have been summarized (6). Concentrations of from 50 to 311 micrograms N/liter have been considered critical. Engineering-Science, Inc. (6) found an average concentration of 10 micrograms N/liter of combined nitrates and ammonia in Lake Tahoe. The Department of Public Health (2) used a less sensitive technique for nitrate measurement and so reported most results as less than 500 micrograms N/liter.

On the basis of the available information it appears reasonable to set, as the objective, the mean annual concentration of total inorganic soluble nitrogen not to exceed 25 micrograms N per liter.

## PLANKTON COUNT

Unlike the test for plankton growth potential, the plankton count is a measure of the plankton crop already produced. Thus, this parameter has no predictive value but is indicative of existing situations. Available data on plankton counts have been summarized in two reports (6,2).

The report by the Department of Public Health (2) grouped the results and showed that plankton counts ranging from 1,000 to 10,000 organisms/ml occurred almost exclusively in marinas and in the shallow water areas along the south shore. Samples taken from locations other than marinas showed counts generally below 500 per ml.

The report by Engineering-Science (6) stated the following: "Essentially all of the phytoplankton were diatoms. The number of diatoms in the pelagic region were at a maximum (127-345 organisms per ml) during April and May, and remained at a lower concentration (13.66 organisms per ml) during the remainder of the survey period. In contrast, areas at the south end of the lake, and within the boat harbor at Tahoe City, experienced significant increases in phytoplankton during July. The phytoplankton concentration in the boat harbor increased from 1,260 organisms per ml during April, to 3,890 organisms per ml in July. The offshore phytoplankton concentration near Bijou was 262 organisms per ml during May, higher than the pelagic areas, and it increased to 457 organisms per ml during July.

It is obvious from the variety of data available that no program of sampling has been carried out for the purpose of obtaining precise counts of plankton in Lake Tahoe. Neither has there been a proper attempt to trace the temporal and spatial variations in numbers and types of plankton. The objective, a mean seasonal not to exceed 100 per milliliter, and a maximum not to exceed 500 per milliliter, must be considered tentative.

Since the growth of plankton is affected by seasonal temperature changes, the objective is based on seasonal mean counts rather than annual mean counts.

## C - CHEMICAL PURITY

A comparison of the chemical composition of the waters of Lake Tahoe with Sections 5:21 and 5:22 of the Public Health Service Drinking Water Standards (3), shows the concentrations of chemical substances in the lake waters to be much lower than the concentrations acceptable in drinking water. In fact, levels of many chemical substances which would be acceptable in drinking waters are considered as unacceptable in the lake.

Little is known of the effect of various chemicals, alone or combined, on the clarity or biological enrichment of the lake. We can, however, state that an increase in the concentration of almost any chemical substance would be detrimental to the purity of the waters. For these reasons, and because it is the prime objective of this policy to maintain the waters of Lake Tahoe in their present state of clarity and purity, and to protect all beneficial uses of these waters, we feel justified in setting limits on all chemical substances based on the present concentrations found in the lake.

It is impractical to set limits on all chemical substances for two reasons: first it would be difficult to justify setting limits at the present low concentrations for most chemical substances based upon beneficial uses, and second, the expense of monitoring would be unrealistic as compared to the value of the results obtained.

Conductance and chloride ion concentrations are included as indicators of chemical purity. They are not meant to be justifiable in themselves.

### SPECIFIC ELECTRICAL CONDUCTANCE

The chemical quality of water can be closely approximated by the electrical conductivity. Most soluble minerals, with few exceptions (such as silica, boron, and others) form electrolytes and allow water to conduct a current. Criteria have been established for electrical conductivity suitable for agricultural and domestic use, however, these criteria are far in excess of the values presently found in Lake Tahoe. Since the watershed area around the lake is comprised primarily of decomposed granitics of low solubility, the mineral characteristics of Lake Tahoe are exceptional.

Table 6 is a summary of electrical conductivity values from the Department of Water Resources monthly Surface Water Quality Monitoring Program (12). The values listed show the mean and maximum values for the twelve samples taken during the year. The mean annual value of 95 micromhos specified in the objectives closely represents the average conductance of the lake waters. The maximum conductance of 105 micromhos per cm at 25° C. is exceeded only occasionally.

## Table 6

### SPECIFIC ELECTRICAL CONDUCTANCE
(Micromhos per Centimeter at 25°C)

| YEAR | AVERAGE | | | MAXIMUM | | |
|---|---|---|---|---|---|---|
| | Tahoe[1] Vista | Tahoe[2] City | Bijou[3] | Tahoe[1] Vista | Tahoe[2] City | Bijou[3] |
| 1952 | 96.8 | 97.2 | 94.7 | 100 | 108 | 103 |
| 53 | 93.9 | 92.4 | 90.7 | 97.2 | 95.6 | 96.3 |
| 54 | 95.5 | 95.8 | 93.8 | 97.3 | 102 | 97.8 |
| 55 | 95.0 | 94.0 | 96.2 | 97.0 | 95.3 | 108 |
| 56 | 92.6 | 95.2 | 90.2 | 93.7 | 112 | 95.1 |
| 57 | 94.5 | 93.1 | 88.2 | 104 | 96 | 97 |
| 58 | 94.8 | 93.6 | 92.2 | 105 | 95.2 | 96.1 |
| 59 | 94.5 | 93.6 | 91.3 | 99.3 | 95.7 | 100 |
| 1960 | 94.2 | 96.4 | 93.1 | 100 | 124 | 100 |
| Mean | 94.5 | 94.0 | 92.2 | | | |

1. Tahoe Vista - On a pier 0.1 miles west of Tahoe Vista and 8 miles northeast of Tahoe City.
2. Tahoe City - Upstream from the control gates of the Truckee River.
3. Bijou - At Connolley's Pier.

## CHLORIDE ION CONCENTRATION

Chlorides have been used for many years as an indicator of pollution. Generally speaking, the chloride content of water increases as the mineral content increases. It can therefore be used to detect possible increases in various chemical substances. The chloride ion is not absorbed by soil formations and is not altered or changed in amount by biological processes. Because of its prevalence in most waste waters, particularly domestic sewage, and because of its present low concentration in the lake waters it can be used as a guide to possible sources of degradation.

Criteria for chlorides have been established for agricultural and domestic uses of water. As is the case for electrical conductivity, these values are far in excess of the present conditions found in Lake Tahoe and are not realistic values to preserve the lake's water quality. It is desirable that chloride concentrations be held at present levels.

Historical data have been obtained under the Department of Water Resources Surface Water Quality Monitoring Program (12). Table 7 summarizes data from monthly samples. The data shows the lake to be extremely consistent in chloride concentration. The mean annual specified in the objective (3.0 mg/l) has not been exceeded although the data indicates that it has been closely approached on a number of occasions. The maximum concentration (5.0 mg/l) is meant as a safeguard against pollution occurring for a limited time period.

## Table 7

### CHLORIDE ION CONCENTRATION
(Milligrams per liter)

| YEAR | AVERAGE | | | MAXIMUM | | |
|---|---|---|---|---|---|---|
| | Tahoe[1] Vista | Tahoe[2] City | Bijou[3] | Tahoe[1] Vista | Tahoe[2] City | Bijou[3] |
| 1952 | 2.1 | 2.0 | 2.3 | 4 | 3 | 4 |
| 53 | 2.3 | 2.0 | 2.4 | 3.0 | 3 | 3.5 |
| 54 | 2.1 | 2.1 | 1.8 | 2.8 | 3.0 | 3.0 |
| 55 | 1.7 | 1.4 | 1.5 | 2.2 | 2.5 | 3.2 |
| 56 | 1.3 | 1.4 | 1.6 | 2.3 | 1.8 | 2.4 |
| 57 | 2.5 | 2.4 | 2.0 | 3.0 | 4.0 | 3.0 |
| 58 | 2.7 | 2.8 | 2.7 | 3.8 | 3.5 | 3.8 |
| 59 | 2.9 | 2.8 | 2.6 | 4.8 | 4.8 | 4.1 |
| 1960 | 2.3 | 2.0 | 2.1 | 4.0 | 4.5 | 3.5 |
| Mean | 2.3 | 2.0 | 2.1 | | | |

[1] Tahoe Vista - On a pier 0.1 miles west of Tahoe Vista and 8 miles northeast of Tahoe City.

[2] Tahoe City - Upstream from the control gates of the Truckee River.

[3] Bijou - At Connolley's Pier.

### DISSOLVED OXYGEN

This objective is included to measure the general health of the aquatic environment, to protect fish and other aquatic life, and to serve as an indicator of organic pollution.

A review of available data shows that the dissolved oxygen concentration in Lake Tahoe is consistently nearly equal to or greater than the saturation value (6) (12). No reliable information has indicated that a concentration below 90% of saturation is common or natural to the lake waters. The objective has therefore been established to maintain the dissolved oxygen concentration at greater than 90% of saturation, and intended to retain the waters at their present quality. Although 90% of saturation is more conservative than is normally tolerated in water quality control, values below this would indicate unnatural and therefore undesirable conditions.

### HYDROGEN ION CONCENTRATION AS pH

The pH in natural waters is a controlling factor in determining the presence and distribution of aquatic organisms. Each aquatic organism has its toleration range of pH, terminated by a maximum and minimum value with an optimum at some intermediate position. Generally speaking, the aquatic environment will be protected for all beneficial uses if the pH is maintained within the range of 6.5 to 8.4.

A review of available data indicates that the pH of Lake Tahoe waters consistently falls within the range of 7.0 to 8.4, (6) (12). No reliable information has indicated that values outside this range are common to the lake waters. The objective has therefore been established to maintain the pH within the range, and intended to retain the waters at their present quality. Although this range is more narrow than is normally tolerated, values outside would indicate unnatural and therefore undesirable conditions.

## D - PHYSICAL NATURE

### CLARITY

Lake Tahoe's beauty is due to its natural alpine setting and its unique clarity. It is so clear that the normal devices for measuring the clarity of water such as a Jackson Candle Turbidimeter, are useless in the crystal clear waters of Lake Tahoe. For example, a Secchi Disk can often be observed at depths up to 100 feet which renders this device useless for shallow depths along the shoreline.

This makes it necessary to measure light transmissibility by the use of an instrument which can determine the amount of light penetrating to a particular depth. The Jackson Candle Turbidimeter, or the hydrophotometer are both capable of such measurements. The Jackson Candle is inconvenient to operate in turbidity ranges below 25 units, which makes it necessary to rely on the hydrophotometer. This device uses two photo-electric cells, one slightly above the surface of the water to measure incident light, and the other to measure the percentage of this light penetrating the vertical column of water overlying the second cell which is immersed to a specific depth.

Both the Engineering-Science studies in 1962 (6) and the California-Nevada Surveillance Program (13) included readings of light transmittance with hydrophotometers. Although the data are limited it does appear feasible to develop a water quality objective based on this method of measurement.

The utilization of an extinction coefficient is based primarily on the work presented by Hutchinson (14) which was used in the Engineering-Science Study of the Lake Tahoe Basin published in June 1963. The vertical extinction coefficient is the rate of decrease of light transmissibility in relation to the depth of water.

Almost all of the available hydrophotometer data have been plotted on a semi-log graph, and the visual appearance of the water (clear, slightly turbid, or turbid) was noted for each curve. In evaluating these data it became obvious that all observations showing an extinction coefficient lower than 0.08 per meter were in the "clear" range, while those in excess of the recommended value were "slightly turbid" or "turbid", with few exceptions. It is realized that data at the present time are limited and that the recommended value may be changed following an additional year of data accumulation and evaluation.

The measurement of light below the surface of the water with a hydrophotometer generally requires the use of a factor to correct for the index of refraction of light entering the water at other than a vertical angle. It is common practice, however, to avoid the use of a correction factor by obtaining a hydrophotometer reading when the sun is almost directly overhead. Rather than complicate the technique of light measurement by correcting for the index of refraction, it is proposed that hydrophotometer measurements be made two or three hours prior to and after the sun is directly overhead. The same approach was utilized in the Engineering-Science study (6).

The determination of clarity using a hydrophotometer is not a rapid procedure and is not commonly used by regulatory and investigative agencies. For this reason an additional requirement using Turbidity Units was specified. Although the Jackson Candle method of determining turbidity cannot determine values less than 25 units, without cumbersome methods of preparing dilution standards, an instrument called the "Hach CR Low Range Turbidimeter" can read between 0 to 5 Turbidity Units with satisfactory accuracy. The joint objective (hydrophotometer and Turbidity Units) will ensure the continuing lakewide clarity.

## FOREIGN MATERIAL

Justification for an objective limiting foreign offensive material is obvious. The existence of tin cans, newspapers, garbage, or other trash is detrimental to the aesthetic values of Lake Tahoe, and cannot be tolerated. Rather than listing the specific material which should not be allowed in Lake Tahoe, it was considered better to completely eliminate and control all materials which adversely alter natural conditions. The occasional existence of natural materials in the lake, such as pollen, leaves, pine needles, and spider webs sometimes reaches objectionable levels, but no man-made sources should be allowed to aggravate these occasional natural conditions.

## TASTE AND ODOR CAUSING SUBSTANCES

It is the intent of this objective that the waters of Lake Tahoe remain as free from tastes and odors in the future as they are today.

It would be exceedingly difficult to provide numerical values to measure the threshold properties of taste and odor since the sensitivity or perceptiveness differs in individuals. In addition, the existence of taste and odor, even at the threshold level, is an undesirable condition not to be tolerated in Lake Tahoe.

The utilization of pesticides, and the increasing use of chemicals, could create localized conditions of undesirable tastes and odors. For this reason it is necessary to include an objective for tastes and odors and to establish limits at zero rather than at an indefinite threshold of detectability.

Since the recommended objective is based on no foreign taste or odor in the water, the existence of foreign tastes or odors should not be detectable by any person, even a person having the most acute sense of taste or smell.

# CHAPTER VIII.

## DEFINITION OF TERMS

In order to assure consideration of water quality control policy in the light of common understanding, the following definitions are set forth:

WATER QUALITY CONTROL is the control of any factor which adversely and unreasonably impairs the quality of the waters of the State for beneficial use.

WATER QUALITY FACTOR is any action, condition, or circumstance which alters water quality, or which alters the level of water quality indicators.

A WATER QUALITY INDICATOR is a water impurity or characteristic which serves as a measurement of quality. Examples of indicators are: Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), pH, Chloride, Sulfate and Alkyl Benzene Sulfonate (ABS).

WATER QUALITY CONTROL POLICY is the formulation of water quality objectives for affected waters of the State where water quality control measures are necessary or may be needed in the future to assure suitable water quality for beneficial use.

A WATER QUALITY OBJECTIVE is a limit or level prescribed for a water quality indicator. The prescribed limit should be quantitative and precise insofar as practicable, but in the absence of precise measurement techniques may be expressed in terms of characteristics desired.

# CHAPTER IX.

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"A Treatise on Limnology, Vol. I." John Wiley & Sons, 1957.

# APPENDIX D

## SOUTH TAHOE PUBLIC UTILITY DISTRICT
## SOUTH LAKE TAHOE, CALIFORNIA

PRESENTATION TO THE

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
CONFERENCE ON POLLUTION
OF LAKE TAHOE

JULY 18-19, 1966

**BOARD OF DIRECTORS**

Robert Fesler - President

Robert Wakeman

Donald Kortes

Edward Hegarty

George Melikean, Sr.

## TABLE OF CONTENTS

### TEXT

I HISTORY

II EXISTING SEWERAGE FACILITIES

III ULTIMATE SERVICE AREA

IV IMMEDIATE PLANNED IMPROVEMENTS

V FINANCIAL CONSIDERATIONS

VI FUTURE NEED OF AREA

VII CONCLUSIONS

### EXHIBITS

PLATE A - SEWER CONNECTIONS

TABLE 1 - TYPICAL TREATMENT PARAMETERS

TABLE 2 - SEWAGE QUANTITY

MAP OF SERVICE AREA AND FACILITIES

## I. HISTORY

The South Tahoe Public Utility District is a public agency formed under the provisions of the State of California Public Utilities District Act of 1921. The District is empowered to provide its inhabitants with sewage disposal, garbage and refuse disposal and other specific services. However, since its formation, this District has provided only one service and that is the collection, treatment and disposal of sewage.

The District was established in 1950 and originally comprised about 250 acres with an assessed valuation of $1,140,000.

The District began sewer service in 1956 with sewerage facilities consisting of one septic tank, a pump station and force main, and a few thousand feet of collector sewers.

The District now encompasses approximately 10,000 acres, extending from the Nevada-California boundary on the north, to the foot of Echo Summit on the south, as shown on the attached map. Practically all developed areas at the South Shore are within its boundary. The assessed valuation is presently in excess of $50,000,000. During the summer of 1965 the sewage from a population of 33,000 was treated at the District's facilities.

During the past fifteen years, the District's area has increased by a factor of 40 and the assessed valuation has increased by a factor of 50. This explosive growth is but an indication of what is yet to come.

## II. EXISTING SEWERAGE FACILITIES

The greatest majority of the existing sewerage system has been constructed since 1959. The system is therefore an essentially new facility designed in accordance with latest engineering knowledge and constructed with modern materials utilizing skilled workmanship.

The collection system contains approximately 125 miles of 6-inch through 24-inch sewers. There is an additional 44 miles of 4-inch sewer laterals extending from the collectors to individual lots. Approximately 4500 acres are served by the system, representing about 15,000 equivalent residential lots. As of July 1, 1966 there were about 5000 active connections to the system. Plate A shows the number and type of connections now existing.

The collection system includes seven pump stations and 10 miles of pressure sewer. All sewage is transported to the treatment plant by pump stations.

The treatment plant was constructed in 1960 and included both primary and secondary treatment. Secondary treatment is accomplished by a standard rate activated sludge process. Sludge is digested and then dried in beds. In 1965 a tertiary treatment plant was added. This process consists of chemical coagulation of the secondary effluent, filtration through separation beds and adsorption by activated carbon columns. The separation beds remove practically all of the suspended solids and more than 98 percent of the phosphates. The carbon columns remove more than 80 percent of all organic material and 99 percent of the ABS found in the secondary effluent. Table I summarizes the overall efficiency of the treatment process through the first year of tertiary plant operation. The design capacity of the existing treatment plant is 2.5 million gallons per day.

Effluent disposal is accomplished by spray irrigation on land. Approximately 250 acres of U.S.F.S. lands are under use permit to the District for this purpose. Over 300 acres of private land has now been leased, for a two year period, for an additional temporary disposal site.

The existing treatment plant is capable of serving 30,000 persons. The existing sewer system is capable of serving about 50,000 persons. With planned increases to pump stations and some added trunks, the system can serve about 90,000 persons.

The system presently serves primarily the area within the new City boundaries.

In addition to serving the population within the District, sewage treatment and disposal are provided by contract to the Douglas County Sewer Improvement District No. 1, in Nevada. The contract has been in existence since 1953 and will be terminated by 1968 when the Nevada District will have its own treatment and disposal facilities. The Nevada District contributes approximately 25 percent of the present total plant flow.

## III. ULTIMATE SERVICE AREA

As previously mentioned, the District now contains about 10,000 acres including most of the presently developed land at the South Shore. According to the Lake Tahoe Area Council Comprehensive Study of 1963, and other studies, the South Shore ultimate sewer service area will contain over 30,000 acres and a peak summer population of 280,000 is anticipated. As shown on the attached map, the ultimate service area will extend from the State line on the north to Lutner Pass on the south, westerly to Echo Lake and Emerald Bay and easterly to approximately the 7,000 foot elevation.

Within this general area much land, both private and public, is of course now completely undeveloped. How much of the land will eventually be developed and require sewerage, will be dependent to some extent on land use patterns and growth patterns yet to be developed. Nevertheless, the ultimate population may well be reached and the long range planning for sewerage facilities is therefore predicated on the ultimate population.

Table 2 shows the actual and estimated sewage quantity by year starting with 1962 and ending in the year 2000. Table 2 also shows the maximum month and minimum month flows for the same period.

## IV. IMMEDIATE PLANNED IMPROVEMENTS

To keep abreast of the predicated growth and to provide immediately needed facilities the District has begun expansion of all elements of the system. Each of these major improvements will be briefly outlined.

a. The newly annexed area of Meyers in the southern part of the District, requires a major trunk sewer system and collector sewers to provide service to developed areas. Some collection sewers are now being installed in new subdivisions and others are planned for immediate installation. The trunk system will contain approximately 80,000 feet of sewers ranging from 24-inch to 10-inch in size. Two major pump stations and force mains will be constructed. This system is now under design and initial construction is scheduled for November 1966. This system will provide immediate service to over 4500 acres, presently served only by septic tanks, by the end of 1967.

b. A second major expansion of the collection system is now in the preliminary planning stage. This expansion will serve about 3500 acres of U.S. Forest Service land located to the west of the present District boundary. Completion of these improvements will be dependent upon the Forest Service's financial program. When completed the system will serve the Fallen Leaf Lake and Emerald Bay area and all public lands along the South Shore of Lake Tahoe.

c. Plans are completed for expansion of the treatment plant to 7.5 million gallons per day capacity and construction bids will be opened Tuesday, August 9, 1966. This expansion includes primary, secondary and tertiary treatment facilities. The expanded facilities will be similar to those existing. The expanded tertiary plant provides for the possible future inclusion of nitrogen removal facilities. In addition the plant will include equipment for dewatering and incineration of sewage sludge, and for recalcining and reuse of the coagulant.

The plant design is based on recommendations of the 1963 Lake Tahoe Area Council Comprehensive Study where it is concluded that effluent disposal out of the Lake Basin, will require an effluent of essentially drinking water quality, and that tertiary treatment to obtain maximum removal of phosphates and nitrogen appears to be the type of design most suited at Tahoe if in-basin disposal is even to be considered.

d. Effluent disposal will be accomplished by removal of the effluent from the Lake Tahoe basin. This portion of the District's program has been the most difficult to achieve and the present solution is the culmination of several years efforts by many people, both within and without the District.

The planned effluent disposal system consists of three distinct parts, the status of each of these parts will be briefly described.

(1) Plans for the Luther Pass pipeline are complete and construction bids will be opened at 3 P.M., Monday, August 8, 1966. This pipeline is approximately 15 miles long and extends from the treatment plant to the summit of Luther Pass. Included in this project are two pump stations, one at the treatment plant and another at the foot of Luther Pass. The effluent will be lifted a total of 1470 feet to the summit from where it will be carried by gravity to the disposal area in Alpine County. The initial phase of this project will have a capacity of 7.5 million gallons per day and is designed for economical expansion to 15.0 million gallons per day. Construction is to be completed by September 1967.

(2) From Luther Pass the effluent will be carried in a gravity pipeline into Alpine County. This pipeline will extend from Luther Pass to the vicinity of Woodfords, in the Carson River watershed. The pipeline will be about 12 miles long and will terminate in the proposed Indian Creek Reservoir. Plans for this line are in preparation and construction is scheduled to begin later this year, with completion scheduled for September 1967.

(3) The proposed Indian Creek Reservoir will have a maximum capacity of 3225 acre feet and a surface area of 165 acres. The reservoir

will be impounded by a main dam with a height of 63 feet above streambed and a crest length of 1440 feet. The reservoir will provide storage for irrigation purposes and would include recreational functions, assuming, sufficiently high water quality standards would be maintained. Outflow from the reservoir will eventually reach the East Fork of the Carson River.

Preliminary engineering plans and cost estimates have been completed for the dam and reservoir. Final design is scheduled for completion in January 1967. Construction is scheduled to begin in April 1967 and to be completed in October 1967, assuming financing and legal requirements have been satisfied.

Completion of the previously described improvements will result in elimination of a major source of possible sewage pollution to Lake Tahoe. However, the program described is only the first stage of a continuing program that is necessary if growth of the area continues in the future as it has in the past.

## V. FINANCIAL CONSIDERATIONS

The key to any program conceived for the purposes described herein is money. Sewage disposal has historically been a difficult area in which to obtain strong public support. Lake Tahoe, despite its unique considerations, is similar to the other areas in this respect. A local district, supported only by a local tax base, can provide just a certain amount of financial support for a specific function. When the specific function, in this case sewage disposal, becomes greatly more than ordinarily required of similar local entities, financial considerations weigh even more heavily than usual.

In the last 10 years the District has invested the following sums for sewage disposal:

| | |
|---|---|
| Collection Systems | $ 8,000,000 |
| Pump Stations | 400,000 |
| Treatment Plant | 2,500,000 |
| Disposal Facilities | 600,000 |
| Total | $ 11,500,000 |

Practically the entire sum has been derived from local sources either through bonded indebtedness, direct taxation or other local revenue. Present bonded debt is approximately 10 million dollars, which includes $6,000,000 for collection system and $4,000,000 for treatment and disposal. Of the $11,500,000 total investment, Federal grants of $320,000 have been received and another $170,000 promised but not yet paid. No State financial assistance has been received.

The forthcoming immediate improvements are proposed to be financed in the following manner:

1. Treatment Plant and Luther Pass Pipeline:

| | | |
|---|---|---|
| Estimated Total Cost | | $4,292,000 |
| Federal Grant (P.L. 89-136) | $3,142,000 | |
| District Funds (Revenue Bonds) | 1,150,000 | |
| Total | $4,292,000 | |

2. Woodfords Pipeline and Disposal Area:

| | | |
|---|---|---|
| Estimated Total Cost | | $3,300,000 |
| Federal Grant (P.L. 84-660) | $ 990,000 | |
| State Grant & Loan Funds | 2,310,000 | |
| Total | $3,300,000 | |

3. Meyers Trunk Sewer System:

| | | |
|---|---|---|
| Estimated Total Cost | | $2,000,000 |
| District Funds (General Obligation Bonds) | $2,000,000 | |
| Total | $2,000,000 | |

4. U.S.F.S. Trunk Sewer System:

| | | |
|---|---|---|
| Estimated Total Cost | | $1,700,000 |
| Federal Funds | $1,700,000 | |
| Total | $1,700,000 | |

The capital expenditures for the immediate expansion program totals $11,292,000. Of this sum $5,460,000 is proposed to be from local District funds supplemented by State Loans and/or Grants. Federal funds of $5,832,000 are expected to provide the balance, with $1,700,000 of this amount to be solely for facilities constructed to serve federal facilities.

In addition to the capital amounts set forth, District operational and maintenance costs for treatment and disposal will average more than $800,000 annually during the 1966-1970 period. Of this amount, over

$100,000 annually will be spent for effluent pumping costs. During the same period, debt retirement (not including assessment bonds) will cost an additional $400,000 annually, for a total annual budget of over $1,200,000. This sum is paid for through revenues derived from service charges, fees, and ad valorem taxes.

## VI. FUTURE NEED OF AREA

Assuming predicated growth patterns occur, by the year 2000 some 270,000 persons will be living or visiting within the South Tahoe ultimate service area. To accommodate the needs of this population, the sewage treatment and disposal system will have to be expanded to a capacity of 20 million gallons per day. This is 8 times the size of the existing plant, and 3 times the size of the system expansion now ready to be constructed. In addition to the treatment and disposal facilities, collection systems will be added and expanded, trunk sewers will be added, and pump stations and force mains increased in capacity.

Based on present-day costs, the future investment at the South Shore will be of the following magnitude:

| | | |
|---|---|---|
| 1. | Collection Systems (25,000 acres) | $50,000,000 |
| 2. | Trunk Sewers and Pump Stations | 10,000,000 |
| 3. | Treatment Plant | 7,000,000 |
| 4. | Disposal System | 5,000,000 |
| | TOTAL | $72,000,000 |

The single largest expenditure is for collector sewers. These expenditures in the past have been and in the future will be borne solely by the property owners benefited.

The next largest expenditure is for treatment and disposal. Of the $12,000,000 approximately $2,000,000 is for tertiary treatment and $5,000,000 for the disposal system. These expenditures are unusual and are necessary only to protect the present esthetic values of Lake Tahoe water.

The last expenditure is for trunk sewers and pump stations and has in the past been paid for by local funds. The only unusual aspect here is the necessity to provide relatively large initial investments for present lightly populated areas in order to assure that most domestic sewage can be collected and disposed of so as to prevent possible pollution of the Lake.

## VIII. CONCLUSIONS

The foregoing has given a brief description of what one local agency has done, is doing and hopes to do in order to help preserve Lake Tahoe as one of our great national resources.

This District was created fifteen short years ago by a few farsighted local individuals. In this time the District has expended many millions of dollars, all of which was provided from local sources. In any other area of the State or County the system, as it now stands, would be considered an excellent pollution control measure. Yet at Lake Tahoe it is not adequate.

The Board of Directors recognized this fact in 1960 and has worked since that times towards a solution that would assure positive protection to the

Lake within South Tahoe's area of responsibility. The present program has been conceived locally, guided to maturity with assistance from the County and State, and now has been financed in large measure by non-reimbursable Federal Funds.

We believe the program is an outstanding example of what can be accomplished by local initiative, when the tremendous sources of State and Federal government are utilized to cooperate and actively assist in solution to a unique problem.

Finally, the District would stand on its record and state without reservation that Lake Tahoe is not now polluted, that future danger of pollution from sewage effluent at present is minimal and that the District will continue an aggressive policy of expansion and construction to further minimize any possible future threat to the Lake.

To assist the District and other local agencies in continuing the program of pollution prevention, we believe the Federal Government working cooperatively with the State, can and should be of active help.

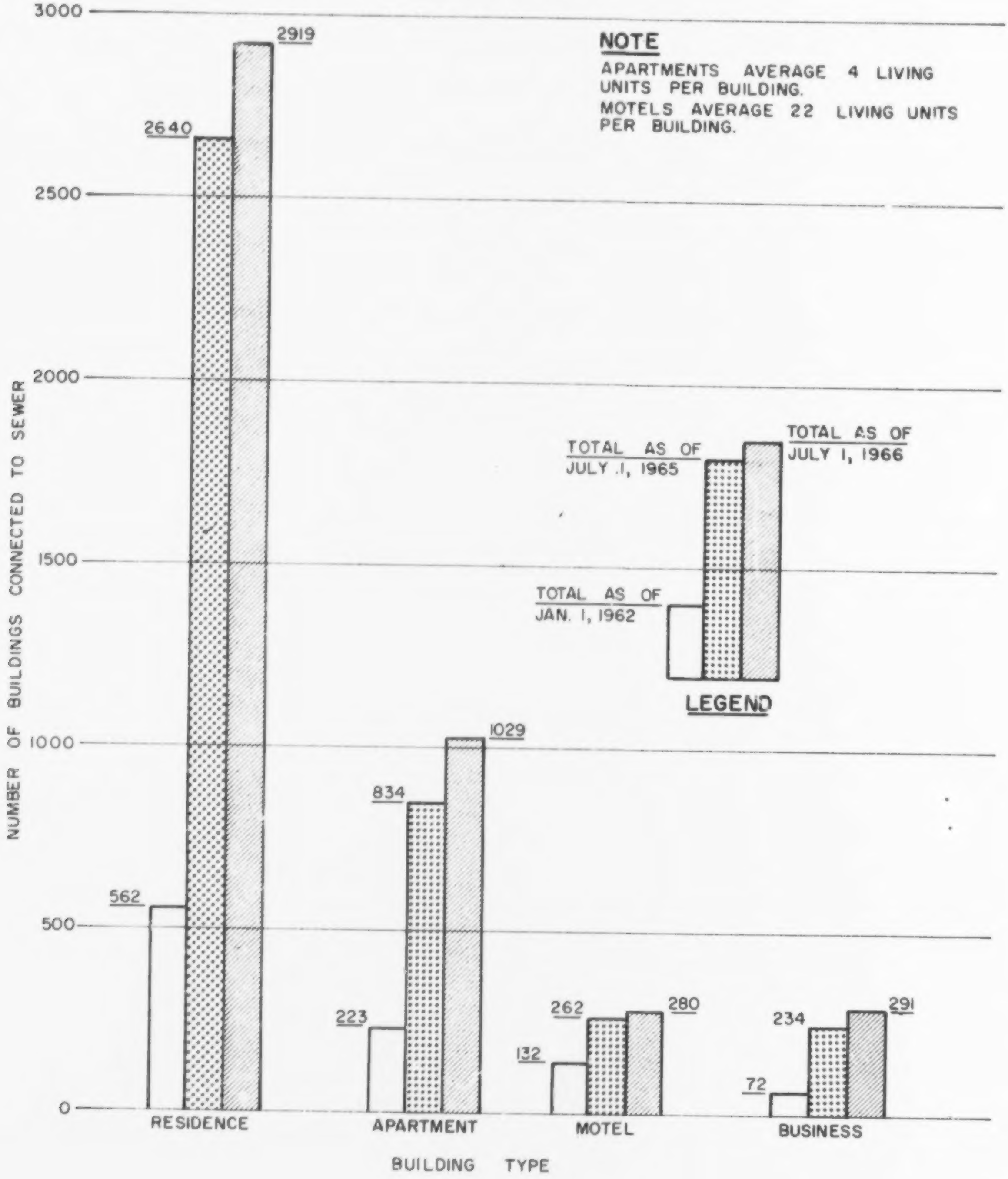
Specifically, there are some areas where the Department of Interior can be of great assistance.

1. To assist in providing adequate funds and encouragement to other Departments of the Federal and State Government so that Federally operated facilities of the Lake can be connected to public sewer systems as soon as reasonably possible. This action above, could if properly

planned and programmed, be of great aid in providing initial sewerage to other remote areas in the Basin.

2. To continue, and expand upon, existing research and demonstration grants in the areas of advanced waste treatment and nutrient enrichment of the Lake, and new programs for control measures that can be developed.

3. To assist local and state agencies in reviewing means of financing the impressive and unique expenditure that will be required in order to completely sewer the Lake Basin. The total cost of such a program has not yet been ascertained. There is no doubt, however, that local financial sources are and will continue to be completely inadequate to finance any such ambitious program within the foreseeable future.



SOUTH TAHOE PUBLIC UTILITY DISTRICT

SEWER CONNECTIONS

PLATE A

## SOUTH TAHOE PUBLIC UTILITY DISTRICT
## WATER RECLAMATION PLANT
## TYPICAL TREATMENT PARAMETERS

| | Raw Sewage | Secondary Effluent | Separation Bed Effluent | Carbon Column Effluent |
|---|---|---|---|---|
| BOD, mg/l | 200-400 | 20-100 | 1 | 1 |
| COD, mg/l | 400-600 | 80-160 | 30-60 | 3-25 |
| Total Organic Carbon, mg/l | --- | --- | 10-18 | 1-6 |
| ABS, mg/l | 2.0-4.0 | 1.1-2.9 | 1.1-2.9 | .01-0.50 |
| $PO_4$, mg/l as $PO_4$ | --- | 25-30 | 0.1-1 | 0.1-1 |
| Color, units | --- | --- | 10-30 | 5 |
| Turbidity, units | --- | 30-70 | 0.5-3 | 0.5-1 |
| Nitrogen | | | | |
| Organic N, mg/l as N | 10-15 | 4-6 | 2-4 | 1-2 |
| Ammonia N, mg/l as N | 25-35 | 25-32 | 25-32 | 25-32 |
| $NO_3$ and $NO_2$, mg/l as N | 0 | 0 | 0 | 0 |
| Unchlorinated | | | | |
| Coliforms, MPN/100 ml | --- | 2,400,000 | 9,300 | 11,000 |
| Fecal Coliforms MPN/100 ml | --- | 150,000 | 930 | 930 |
| Chlorinated | | | | |
| Coliforms MPN/100 ml | --- | --- | 8.6 | 2.1 |
| Fecal Coliforms, MPN/100 ml | --- | --- | 2.1 | 2.1 |

TABLE 1

## SOUTH TAHOE PUBLIC UTILITY DISTRICT
## SEWAGE QUANTITY

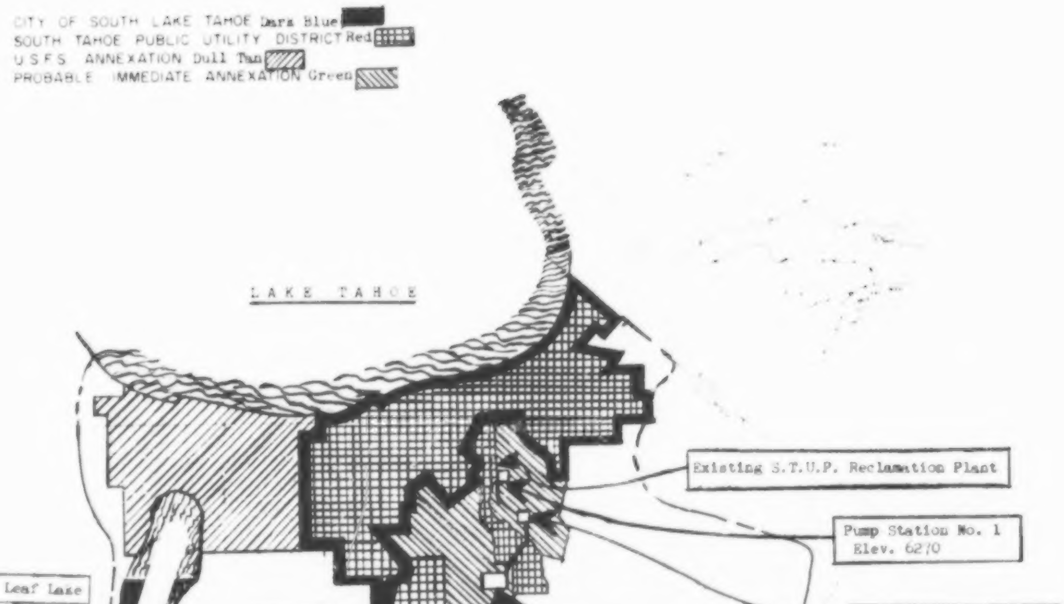
| Year | Total Flow M.G./Year | Average Daily Flow M.G./Day | Max. Month M.G./Mo. | Min. Month M.G./Mo. |
|---|---|---|---|---|
| 1962 | 374.37 | 1.03 | 41.00 | 21.00 |
| 1963 | 480.72 | 1.32 | 58.30 | 30.50 |
| 1964 | 533.41 | 1.46 | 62.10 | 34.90 |
| 1965 | 707.32 | 1.94 | 79.45 | 49.10 |
| 1966 | 800 | 2.2 | 85 | 52 |
| 1970 | 1,200 | 3.3 | 160 | 95 |
| 1975 | 1,600 | 4.4 | 220 | 140 |
| 1980 | 2,000 | 5.5 | 280 | 180 |
| 1985 | 2,400 | 6.6 | 340 | 220 |
| 1990 | 2,800 | 7.7 | 400 | 260 |
| 1995 | 3,300 | 9.0 | 470 | 310 |
| 2000 | 3,800 | 10.4 | 550 | 380 |

M.G./ Year - Million Gallons Per Year
M.G./ Day - Million Gallons Per Day
M.G./ Month - Million Gallons Per Month

TABLE 2

# SERVICE AREA AND FACILITIES
FOR
# SOUTH TAHOE PUBLIC UTILITY DISTRICT
BIJOU, EL DORADO CO., CALIFORNIA

CLAIR A. HILL & ASSOCIATES
CONSULTING ENGINEERS


CITY OF SOUTH LAKE TAHOE Dark Blue ■
SOUTH TAHOE PUBLIC UTILITY DISTRICT Red ▦
U.S.F.S. ANNEXATION Dull Tan ▨
PROBABLE IMMEDIATE ANNEXATION Green ▧
LAKE TAHOE
Fallen Leaf Lake
Lower Echo Lake
ULTIMATE SERVICE AREA BOUNDARY
Existing S.T.U.P. Reclamation Plant
Pump Station No. 1 Elev. 6270
Existing Holding Basin
ULTIMATE SERVICE AREA BOUNDARY
Existing Disposal Area
N
PUMP STATION NO 2 ELEV. 6500
LUTHER PASS EXPORT LINE
LUTHER PASS
TO DIAMOND VALLEY

# APPENDIX E

## STATEMENT OF CLINTON E. WOOSTER, DISTRICT ATTORNEY OF WASHOE COUNTY, NEVADA (SUBMITTED BY DAVID HENRY)

April 6, 1966

## MEMORANDUM

RE: Control of water pollution in the Truckee River

This memorandum deals with the problem of what agencies within the State of Nevada have control over water pollution in the Truckee River in the State of Nevada. It is my general conclusion that primary responsibility for pollution of the Truckee River rests with the State of Nevada acting through the Health Division of the Department of Health and Welfare. However, local municipalities through the general authority granted them under the police power to legislate for public health and welfare and the powers granted to the District Board of Health by statute also create both responsibility and authority for exercise of some control over pollution in the Truckee River insofar as that pollution extends into their respective jurisdictions. Finally, the County may have some basis for controlling pollution in the Truckee River within Washoe County pursuant to certain statutory enactments among them a 1965 statute which now give counties in the State of Nevada the power to legislate with regard to local police and sanitary ordinances and regulations within the County. This memorandum is divided into three parts dealing with the State, local agencies, and finally the Federal government.

### 1. STATE OF NEVADA

NRS 445.010 makes it unlawful to pollute a river or stream in the State of Nevada. NRS 445.020 authorizes the Attorney General with the consent of the Governor to commence action to prevent pollution of any river or stream within the State of Nevada whether the source of such pollution be within or without the State of Nevada. NRS 445.030 make it unlawful for anyone to furnish impure water for public or private use. It appears that the primary responsibility to prevent pollution of water is vested by the above quoted statutes in the State of Nevada. It should be especially noted that the Attorney General has been specifically authorized to prevent pollution of waters where the pollution occurs outside the State of Nevada. Inasmuch as the Truckee River is an interstate river, and inasmuch as pollution of the Truckee River may very well originate outside the State of Nevada, it would seem that NRS 445.020 authorizing the Attorney General to abate pollution where the source is outside of the State of Nevada would specifically create a responsibility in the State of Nevada to prevent pollution of the Truckee River where pollution occurred in California. I have been unable to find any other specific statutory or City Charter reference which empowers anyone in the State of Nevada specifically to bring a proceeding to abate water pollution when the source of the pollution occurs outside of the State of Nevada.

In addition to the specific statutory language on water pollution NRS 439.200 reads in part as follows: (1) "The State Board of Health shall have the power by affirmative vote * * * to adopt * * * rules and regulations consistent with law: * * * (1) To provide for the sanitary protection of water and food supplies and the control of sewage disposal. (2) Such rules and regulations shall have the force and effect of law and shall supersede all local ordinances and regulations heretofore or hereafter enacted inconsistent therewith." (underlining mine) This statutory provision reinforces the point above made that the primary responsibility for abatement of water pollution rests with the State of Nevada. The Statute quoted above is an enabling act which has enabled the State Board of Health to pass regulations on water supplies. The State Board of Health adopted water supply regulations on January 8, 1952. Section i of these regulations provides that every drinking, culinary and ablutionary water supply which is hereafter constructed or extensively reconstructed or every existing water supply which in the opinion of the State Health Department is unsafe or subject to the danger of contamination by reason of unsatisfactory location, protection, construction, operation or maintenance, shall be made to comply with requirements of these regulations. Section 3 of the regulations deals with contaminated water supplies and provides in the last sentence: "The supply should not be used until the tests show that the water conforms to the bacteriological requirements of the United States Public Health Service Drinking Water Standards."

It should be specifically noted that the Water Supply Regulations adopted by the State Board of Health on January 8, 1952 under the provisions of NRS 439.200 supersede all local ordinances and regulations enacted that may be inconsistent with these regulations. It would be my opinion that based upon the statutory provisions quoted above together with the enactment of Water Supply Regulations by the State Board of

Health, the primary responsibility for the control of water pollution in the Truckee River rests with the State of Nevada.

2. LOCAL AGENCIES.

For purposes of this memorandum I have analyzed the provisions of the Sparks City Charter and the statutory provisions controlling Washoe County. No attempt has been made to analyze the provisions of the City Charter of the City of Reno. However, I feel that the general law is much the same. There is no City Charter provision that specifically governs water pollution. However, the Sparks City Charter in Section 3.42 provides in part as follows: " * * * and to prevent the depositing of sewer filth, offal, manure, or other offensive matter within the City; " in addition, the Sparks City Charter in Section 3.44 provides as follows: "Second - To adopt and enforce by ordinance, all such measures and establish all such regulations, in case no express provision is in this Charter made, as the Council may, from time to time, deem expedient and necessary for the promotion and protection of health, comfort, safety, life, welfare and property of the inhabitants of said City * * *."

By Chapter 81 of the 1965 Statutes of Nevada each Board of County Commissioners has now been empowered to enact and enforce such local police and sanitary ordinances and regulations as are not in conflict with the general laws and regulations of the State of Nevada. NRS 244.365 empowers the Board of County Commissioners of any County in the State of Nevada to institute and maintain suits in any court of competent jurisdiction against any persons depositing sawdust in any river or stream, the waters of which run partly or wholly in the State of Nevada. In addition, NRS 244.360 authorizes the Board of County Commissioners to take action to abate a nuisance as defined by NRS 40.140 when such exists within the limits of the County. A nuisance is defined by NRS 40.140 as anything which is injurious to health, or indecent and offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property.

Putting these general grants of power together it would seem to me that there is responsibility upon the local subdivisions of government to take whatever steps are necessary either to request the State to meet its primary responsibility of preventing pollution of an interstate river or to take independent action. This is reinforced by the general law on point. In McQuillin, Municipal Corporation, 3rd Edition, Volume 7, Section 24.265, the author states as follows: "Municipal corporations ordinarily have express power to secure and protect an adequate supply of pure water for human consumption, or they may do so under their police power. A municipal corporation may protect its water supply from pollution or contamination. It may require that the water supply be pure and that it be properly chlorinated."

In 37 Am. Jur., "Municipal Corporations", Section 288, page 926, the following is stated:

> "The control of local health and sanitary matters is one of the powers commonly vested in municipalities and is among the chief duties of municipalities under and in connection with their police powers. It is a well settled maxim that 'the health of the people is the first law' and the legal authority wisely lodges in munici-

> pal bodies discretion and power adequate for its protection, so that they may enact all ordinances proper to provide and enforce sanitary regulations. Municipal police power is frequently exercised for the health and comfort, the health and cleanliness, the public health and general welfare, the public health and morals, and the public health and convenience of municipal and densely populated communities. Ordinances to preserve the public health have been liberally construed, and the authorities have gone to great length in enumerating the implied powers of municipalities to enact laws to protect the community from infectious and contagious diseases, from bad water, against nuisances injurious to health, and noxious odors and gases. Inasmuch as the preservation of the public health and the safety of the inhabitants is one of the chief purposes of local government, all reasonable ordinances in this direction have been sustained."

Finally, in the Nevada case of Ex Parte Sloan, 47 Nevada 109, 217 Pac. 233 (1923) the Nevada Supreme

Court upheld the power of municipalities in the State of Nevada to pass ordinances pursuant to the police power in spite of the fact that the State had also legislated in the same field. The Courts specifically hold that an act may be prohibited and punished by both municipal and state law.

It would, therefore, be my conclusion that based generally upon the police power granted to cities in their respective city charters and certain general statutory provisions applicable to counties together with the general law on the problem, the cities and counties of this State have responsibility and concurrent jurisdiction in this area for control of water pollution within their respective jurisdiction.

One final point should be noted and that is with regard to the authority of the District Board of Health. A District Board of Health has been created for Washoe County pursuant to the provisions of Chapter 439 of the Nevada Revised Statutes. The District Board of Health is comprised of the Cities of Reno, Sparks and the County of Washoe. NRS 439.410 provides as follows:

"(1) The District Board of Health shall have the power, duties and authority of the County Board of Health in the health district.

(2) The District Health Department shall have jurisdiction over all public health matters in the health district."

NRS 439.350 provides that "The County Board of Health shall: (1) Oversee all sanitary conditions of the County in which the Board is created * * * " These two statutory provisions indicate that the Cities and County pursuant to the general police power by joining together and forming a district health department have also created in this district health department the power to take action with regard to sanitary conditions within the County. This would indicate, to me, that in addition to the residual responsibility of the Cities and the County that there is also jurisdiction in the District Board of Health to take action to prevent pollution of the waters of the Truckee River insofar as that pollution occurs within the jurisdiction of the Distirct Board of Health.

3. FEDERAL GOVERNMENT

In 1948 the Congress of the United States enacted the Water Pollution Control Act (33 U.S.C.A. 466 et. seq.). The Federal Water Pollution Control Act is the major Federal legislative declaration on the problem of water quality control. Congress stated in this Act that as a matter of policy the Federal government would "recognize, preserve and protect the primary responsibilities and rights of the states in preventing and controlling water pollution (33 U.S.C.A. 466 (A)). The Secretary of Health, Education, and Welfare is responsible for administrating the Act and is directed to develop comprehensive programs in cooperation with Federal, State, and Interstate Agencies, municipalities and industries. The Statute specifically provides that when Federal Agencies plan any reservoir, consideration should be given to water quality control by a storage and stream flow regulation. It also encourages enactment of uniform state laws and compacts between the states for the prevention and control of water pollution, provides for the operation and coordination of extensive research programs at every level of government, and upon request of any state, authorizes the Secretary to study specific problems confronting any state or community. The Act supplies grants of Five Million Dollars ($5,000,000.00) per year until June 30, 1968 to states and interstate agencies so that they might establish and maintain adequate measures for prevention and control of water pollution. Pollution of interstate or navigable waters which endangers the health or welfare of any person is subject to abatement. However, abatement of intrastate pollution by the Federal government may be obtained only if the Governor of the State requests such assistance. Abatement of interstate pollution by the Federal government can be achieved upon the initiative of the Secretary, if studies submitted to the Secretary indicate that the health of people living in the state where the pollution does not originate is being endangered. In addition, the Federal government may abate interstate pollution upon the request of a state other than that in which the discharge causing the pollution originates. Enforcement procedures of the Act demonstrate Congress' desire to cooperate with the states, since before Federal Court action may begin, the Department must first attempt to solve the problem by conducting conferences with states involved by holding public hearings on the question .

## 4. CONCLUSION

As stated at the beginning of this memorandum it was my conclusion that the primary responsibility for the abatement of water pollution vests with the State of Nevada. However, as I have tried to indicate in this memorandum the responsibility for the control of water pollution does not end there and there are other agencies which have a legitimate role in the prevention of water pollution. These include the cities and counties through their general police powers and the power to control and abate nuisances, the district board of health, which has jurisdiction by statute to control sanitary matters within the county, and finally by the Federal government itself which through the Water Pollution Control Act of 1948 has taken some steps to aid in the control of pollution of interstate rivers. However, it should be noted that the Federal Act is by and large to be used in cooperation with state agencies rather than with local municipalities in the solution of water pollution problems originating out of interstate rivers. It might be noted in this respect that NRS 445.040-445.070 specifically provide that the Nevada Department of Health and Welfare is designated as the Water Pollution Agency for the State of Nevada for all purposes of control of pollution under the Federal Water Pollution Control Act of 1948.

CLINTON E. WOOSTER

CEW:vc

APPENDIX F

# COMMENTS ON
# THE CALIFORNIA-NEVADA INTERSTATE COMPACT
# PROVISIONAL DRAFT

Prepared for Washoe County, Reno and Sparks

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# CONTENTS

Title — Page

INTRODUCTORY REMARKS 1

PRINCIPAL OBJECTIONS TO PROVISIONAL DRAFT 3

- Provisions Binding the United States Conflict with Established Policy 3
- Certain Agreements Should Precede the Compact 7
- Existing Water Rights are not Recognized and Confirmed 9
- Unnecessary Conflicts between State and Compact Administration 11
- Recourse to the Courts to Enjoin Certain Water Pollution is Denied 15
- No Provision for the Mandatory Replacement of Exported Lake Tahoe Water 16
- Certain Delegations of Power Appear to be Unconstitutional 17

SPECIFIC COMMENTS BY ARTICLE 18

- Article I - Purposes 18
- Article II - Definitions 19
- Article III - Sovereign Relationship 19
- Article IV - California-Nevada Compact Commission 20
- Article V - Lake Tahoe Basin 21
- Article VI - Truckee River Basin 24
- Article VII - Carson River Basin 28
- Article VIII - Walker River Basin 29
- Article IX - Ground Water and Springs 29
- Article X - Interbasin Transfer of Use 29
- Article XI - Suppression of Evaporation 29
- Article XII - Coordination of Reservoirs 30
- Article XIII - Fish, Wildlife and Recreation 30
- Article XIV - Nonconsumptive Use 31

# CONTENTS

Title Page

Article XV - Diversion and Exchange of Yield from Future Reservoirs 31
Article XVI - River Water Quality 31
Article XVII - Change in Point of Diversion, Manner or Place of Use 32
Article XVIII - Imported Water 32
Article XIX - Compact Effect 32
Article XX - Violations 33
Article XXI - Non-impairment of Rights of United States 33
Article XXII - Ratification and Consent 33
Article XXIII - Termination 33

CONCLUSIONS AND RECOMMENDATIONS 34

# COMMENTS ON THE CALIFORNIA-NEVADA INTERSTATE COMPACT PREPARED FOR WASHOE COUNTY, RENO AND SPARKS

## INTRODUCTORY REMARKS

At the request of the joint City-County group of Washoe County, Reno and Sparks, a detailed review has been made of the Interstate Compact provisionally adopted on October 29, 1965, by the joint California-Nevada Interstate Compact Commission. Our comments are directed primarily to the provisions that affect the county and the two cities.

The authorizing act for the Compact states "that the consent of Congress is hereby given to the States of California and Nevada to negotiate and enter into a compact with respect to the distribution and use of the waters of the Truckee, Carson, and Walker Rivers, Lake Tahoe, and the tributaries of such rivers and lake in such states." Consistent with this consent the principal purposes of the Compact are:

(1) To provide for the equitable apportionment of water between the two states and,

(2) To remove causes of present and future controversies, and

(3) To permit the orderly integrated and comprehensive development, distribution, use, conservation, and control of the waters of the three river basins and Lake Tahoe Basin.

In analyzing the provisions of the Compact, we have kept in mind future changes in conditions relating to population and industrial growth, increases in water demands for various uses, changes in points of diversion, nature and places of use of water, requirements for storage reservoirs, conserving water in various ways, pollution control, and increases in recreation.

We shall preface our detailed analysis of, and comments on the draft of Compact by discussing generally the interests of Washoe County, Reno and Sparks in the water and water sources involved, and in the administrative controls of interstate and intrastate water sources proposed by such draft.

The interests of Washoe County, Reno and Sparks in the waters of Lake Tahoe and the Truckee River are proprietary and also governmental in character. Their proprietary rights were acquired and are held for the use and benefit of many thousands of residents and their governmental responsibilities as a County and Cities consist not only of protecting existing water rights, but also of acquiring water rights to insure the future growth and prosperity of the entire Reno-Sparks Metropolitan area. The adequacy of the water supply for outlying agricultural and industrial areas is also of great concern to the commercial center.

Water administration encompasses several functions including the initiation of new rights of use, the distribution of water, pollution control, and the adjudication of existing water rights. These activities are now carried out under complex state statutes. All water users whose rights are affected by an interstate compact are vitally interested in avoiding conflicts between the administrative agency set up by the compact and the established state administrators.

Washoe County, Reno and Sparks in common with all others are interested in using language in the Compact which is simple, concise and clear so that controversy and litigation over its meaning will be minimized.

## PRINCIPAL OBJECTIONS TO THE PROVISIONAL DRAFT

Our comments on the provisional draft of Compact consist, first, of a general discussion of objections under seven appropriate headings of direct concern to Washoe County, Reno and Sparks, and, second, of specific comments, article by article, pointing out matters of substance and language which we believe should be reconsidered by the Compact Commission.

### Provisions Binding the United States Conflict with Established Policy

Article XXII pages 58 and 59 states that this compact shall become effective when, but only if Congress provides in its consent legislation or by separate legislation that some twenty-nine provisions shall be binding on the agencies, wards and instrumentalities of the United States. This, in effect, would make the United States a party to the compact.

Article I, section 10 of the Constitution of the United States provides:

> "No state shall, without the consent of Congress, .... enter into any Agreement or Compact without another state....."

It is apparent from the wording of the constitutional provision that the consent of the Congress is necessary to an agreement or compact between states, and there is nothing in the provision about the United States becoming a party. Furthermore, the language of the compact authorizing act paraphrases the Constitution, "consent of Congress is hereby given."

It has been the policy of the United States expressed in directives of the President to federal representatives and in other documents to require compacting states to use language imposing no restrictions upon the use of water by the United States or upon the power and authority of the United States under the Constitution. In a letter to Mr. R. J. Newell dated May 3, 1950, President Harry S. Truman made the following statement:

> "The purpose of this letter is to call your attention to a problem of growing concern and, in the solution of which, the Federal Representatives assigned to interstate water compact commissions are in a position to perform a valuable public service. I refer to the somewhat recent tendency to incorporate in interstate water compacts questionable or conflicting provisions imposing restrictions on use of water by the United States, such as appear in the Snake River Compact enactment which I approved on March 21, 1950, (Public Law 464, 81st Congress, 2nd Session).
>
> "In this particular case, the possibility of misinterpretation of certain apparently conflicting provisions was not considered to be serious enough to warrant withholding approval of the enrolled enactment of the Congress (S. 3159). Such provisions, however, if followed as precedent for general application, may jeopardize the prospect of consent and approval of compacts by the Federal Government because of the far reaching effects such provisions might have

upon the interests of the United States. This matter is further discussed in a memorandum to me from the Director of the Bureau of the Budget, a copy of which is enclosed for your information and guidance....."

In the accompanying memorandum referred to by the President appears the following statement:

> "...... In its report on S. 3159 the Public Lands Committee of the Senate expressed the view that the compact method is the logical and proper manner to settle interstate water controversies. With this view I am in accord but I am also mindful that compact provisions, which are subject to misinterpretation or leave in doubt the respective rights and interests of the United States and the affected States, serve to impair these rights. It is obvious, therefore, that the compact method places upon the compact commissioners the important responsibility of drawing compacts in specific and unequivocal language, devoid of all possible ambiguity, and which do not attempt to define, limit or otherwise determine the extent of the powers to be exercised by the United States which is a matter for determination by the Congress through Federal legislation as required....."

These quotations are found on pages 198 and 200 in a book entitled, "Documents on the use and Control of the Waters of Interstate and International Streams," published by the Department of the Interior.

In consent legislation on the Arkansas River Compact section 2 of the Act provides:

> "Nothing contained in this Act or in the compact herein consented to shall be construed as impairing or affecting the sovereignty of the United States of any of its rights or jurisdiction in and over the area of waters which are the subject of such compact...." (Act of May 31, 1949, 63 Stat. 145)

Similar language is found in the consent to the Red River of the North Compact. Act of April 2, 1938 (52 Stat. 150).

Most of the latest interstate compacts negotiated between western states have included a provision the same or similar to the following language in Article XIX of the Upper Colorado River Compact:

> "Nothing contained in this Compact shall be cor trued as:
>
> (c) affecting any rights or powers of the United States of America, its agencies or instrumentalities, in or to the waters of the Upper Colorado River System, or its capacity to acquire rights in and to the use of said waters," ...... "

The provisional draft of compact now under consideration not only departs from the precedent discussed above, but expressly provides that, "This compact shall become effective when, but only if .... (3) Congress provides in its consent legislation or by separate legislation that the following provisions of the Compact shall be binding on the agencies, wards and instrumentalities of the United States of America."

This is followed by a reference to the twenty-nine provisions each of which in some manner affects the water rights and activities of the United States.

We believe that this drastic departure from established policy in the negotiation and drafting of interstate water compacts will impede and possibly defeat this effort to compact and respectfully suggest that agreements with the United States defining and limiting its rights in Lake Tahoe and the Truckee River be negotiated in advance of the compact. Although this suggested procedure may seem too slow, it is sincerely believed that in the end it will expedite completion of the compacting process.

We further believe that largely because of the reluctance or refusal of the two states to recognize and confirm the decreed rights of the United States for the Newlands Project, the language of Articles V and VI is so deficient, indefinite and confusing that the draft of compact, if finally approved, would be of little or no value to Nevada and would inject into the present law of Lake Tahoe and the Truckee River (the 1944 decree) much uncertainty and confusion.

## Certain Agreements Should Precede the Compact

Many provisions in the Compact are based on the assumption that problems relating to water rights of the United States will be settled by the Compact or by the Commission after the Compact is in operation. For this reason the Compact is complicated with unsolved legal and engineering problems. These problems could be eliminated if the following agreements were completed prior to ratification of the Compact by the States.

(1) Agreement between California and Nevada for the construction of a weir at the outlet of Lake Tahoe which shall include appropriate provisions on such subjects as the responsibility of each party, construction details and the necessary mechanics for accomplishing the work.

(2) Stipulation between the United States and affected parties for the modification of the 1944 Federal Decree whereby the United States in behalf of the Pyramid Indians will be permitted to change the point of diversion place and nature of use of water decreed to the Indians under claims No. 1 and No. 2 of the Decree.

(3) Stipulation between the United States and the Truckee-Carson Irrigation District for the modification of the 1944 Federal Decree to reduce to a reasonable acreage the award for 232, 000 acres of irrigable lands of the Newlands Project.

(4) Agreement between the United States and the Truckee-Carson Irrigation District modifying the 1926 Agreement to reduce the present figure of 87, 000 acres to some reasonable figure and to reduce the total number of acre-feet to which the project is entitled from all sources of supply.

(5) Stipulation for the entry of the Decree adjudicating the water rights on the Carson River.

There are no compelling reasons why these agreements cannot be completed first as sufficient basic data are believed to be available for that purpose. The Department of the Interior and its agencies have been active during the past two years making studies of the problems related to these agreements. A report on these studies entitled, "Action Program for Resource Development– Truckee and Carson River Basins," was completed October 1964 by a Task Force of the Interior Department, for use in further negotiations with the Truckee-Carson Irrigation District and other interests. Also, good progress has been made during the last few months to reach an agreement on a stipulation that is needed for the entry of the Carson River Decree.

The making of the agreements mentioned above would make possible the recognition and confirmation of existing water rights, the desirability of which is discussed under the next heading.

## Existing Water Rights are not Recognized and Confirmed

One of the principal purposes of an interstate water compact is to provide for the mutual recognition and confirmation by the compacting states of existing rights to the use of the water of a common source. Orderly and complete utilization and distribution of the water of an interstate stream depends upon the accomplishment of this purpose.

In the provisional draft there is no recognition of existing water rights in Lake Tahoe and in the Truckee River and tributaries. Instead, water is allocated to each compacting state to satisfy generally described water rights without identifying or adequately describing the rights to be satisfied, and, indeed, without indicating whether the water rights are vested or are rights which may be initiated in future years. For example, in Article V, entitled, "Lake Tahoe Basin" there is an allocation of 34,000 acre-feet annually from all sources in Lake Tahoe Basin of which 23,000 is allocated to California and 11,000 is allocated to Nevada without (1) stating the priority of such allocated rights as against downstream Truckee River diversions, (2) designating the place of measurment, (3) indicating whether vested rights in the Tahoe Basin will be supplied out of the 34,000 acre-feet, and (4) stating whether the allocation must be supplied out of surplus after satisfying the rights of the United States and others in Lake Tahoe.

Another example is found in Article VI, entitled, "Truckee River Basin." Section A 3 (a) allocates to California 10,000 acre-feet with the second priority without indicating where the water is to be measured, and whether some of the water so allocated can be used to satisfy water rights which have not yet been initiated.

The decrees on the Truckee River and tributaries contain numerous details describing hundreds of separate water rights and providing for detailed water administration including the date of priority of each right, the name of the owner, the name of the ditch, the point of diversion, the place of use, the rate of diversion, the amount to be delivered to the land, and the maximum flow.

The detailed elements of these hundreds of water rights must be recognized in California as in Nevada to assure proper distribution and yet there is nothing in the draft compelling recognition in California for the purposes of either present water administration, or future upstream storage and use.

One of the important laws of the Truckee River system is the Truckee River Agreement of 1935 (also included in the 1944 decree)by and among the United States, the Truckee-Carson Irrigation District, Washoe County Water Conservancy District, Sierra Pacific Power Company and others, which consists of some twenty-five articles covering among others such subjects as rates of flow, pondage and supplemental reservoirs, diversions for municipal, domestic and power use, transportation losses and Pyramid Indian Land Rights. This agreement is not ratified and confirmed in the provisional draft and therefore its legal status against California diversions will be questionable in the event of approval of the draft.

We believe that the only way vested water rights in a lower state can be adequately protected is by recognition of existing rights and uses decreed and otherwise,subject to such conditions as may be necessary to protect the rights in the upstream state. This, the provisional draft carefully avoids.

## Unnecessary Conflicts between State and Compact Administration

Each of the compacting states has comprehensive laws for administration of water, including appropriation, distribution and adjudication. We believe that the compact provisions for administration of interstate waters should interfere as little as possible with state administration, and where there is a conflict the jurisdictional lines between the two should be clearly defined. It has been held that in case of a conflict between a compact provision and the law of a compacting state, the compact provision will prevail. This emphasises the necessity of avoiding conflict wherever possible.

Future projects to increase the municipal and industrial water supply for the rapidly growing Reno-Sparks Metropolitan area will involve both interstate and intrastate storage and diversions of water. The Compact should where necessary set up a definite procedure for interstate appropriations, changes of use and exchanges, but should not contain provisions which would interfere with or raise doubts as to the continued authority of the state administrators to act on water applications involving intrastate projects on interstate streams or other sources. The Compact should not create obstacles to future water projects but should facilitate them. We shall call attention to specific provisions in the existing draft which we believe create such obstacles, or at least cast serious doubts as to the jurisdictional authorities of the commission and the state water administrators.

The wording of Article IX - "Ground Water and Springs" is so general that it would appear that the commission would at least have veto authority over any appropriation of groundwater in the basins covered by the Compact in either state because any diversion to some extent would reduce the stream flow. Does the commission or the state administrator have authority to determine (1) whether there will be a reduction in amount of allocated water caused by spring or ground water development and (2) whether wells near a stream will reduce the surface flow? If there is such reduction what agency will take what action on individual water applications?

The language of Article X - "Interbasin Transfers of Use" would appear to vest in the commission all matters of change of points of diversion and exchanges of water of the Truckee River, Lake Tahoe and the Carson River. Will the individual, corporate and governmental applicants be required to file some sort of application or petition with the commission? If so, no procedure is suggested in the draft of compact. Does the state administrator lose all authority over such change and exchange applications? There is no limitation provided for the protection of existing water rights. This article presents a very serious jurisdictional conflict.

In Article XI - "Suppression of Evaporation" the language is so broad that it is not confined to the water sources covered by the compact. There is an obvious conflict between the jurisdiction of the water administrators and the commission over water savings accomplished by suppression of evaporation. In some instances water savings are accomplished by changes in facilities for storage and diversion such as reducing the size of water surface areas, lowering the water table in swamps or seeped areas, and discontinuing irrigation to reduce evapo-transpiration as was done for the Rye Patch Reservoir Project. This requires expenditure of money to construct works to reduce evaporation under an application approved by the state administrator in many cases. Where does the jurisdiction of the water administrator end and the commission take over? No answer is found in the article.

As written Article XII - "Coordination of Reservoirs" simply authorizes the commission to make plans to achieve the most efficient use of reservoirs, but it is rather innocuous because it does not authorize the commission to carry them out. It would appear to conflict with the statutory water control and distribution authority of state administrators if the plans were enforceable.

In Article XIV - "Nonconsumptive Use" there is serious doubt as to whether the commission or the state administrators have authority to determine whether so called nonconsumptive uses (which are really consumptive uses to some extent) result in a discernible reduction in the water allocated by the Compact.

Article XV - "Diversion and Exchange of Yield from Future Reservoirs" would seem to divest the state administrators of authority over exchanges involving future surface storage projects without setting up a procedure which would not conflict with existing state statutes. It would apply to projects wholly in Nevada on any of the sources involved in the Compact and would appear to take from the State Engineer of Nevada the final approval of intrastate exchanges. This would unnecessarily complicate and possibly defeat future projects to increase the water supply for the growing population in the Reno-Sparks area.

The causes of the conflicts discussed above can be eliminated by confining the jurisdiction of the commission to interstate appropriations, changes of use and exchanges, and by spelling out in clear and concise language procedures to be followed by the commission.

## Recourse to the Courts to Enjoin Certain Water Pollution is Denied

One of the most important duties of municipalities is to provide and safeguard a pure source of water for their citizens. It would seem to be very clear that every remedy now available to prevent pollution of water sources used for municipal purposes should be carefully protected. No remedies should be taken away from the responsible local governing bodies. Yet the language of section H of Article V appears to do just that. The commission is authorized upon a proper showing to permit direct discharge of domestic sewage into Lake Tahoe or tributary streams and is given the right to issue or deny orders to prevent the current or threatened discharge of sewage or industrial waste in one state to the detriment of water quality in another state. There is no provision for court review of the action of the commission. Article V, section H3(c), permits court action only to enforce the order of the commission.

Section I of Article V provides that exportation of waste water shall be made under the "exclusive jurisdiction" of the commission. This would seem to clearly prevent a municipality from seeking court review and injunctive relief against the commission or those acting under a commission to safeguard a water supply against sewage and other waste materials which may be exported from the Tahoe Basin.

Article XVI entitled "River Water Quality," which relates to the Truckee, Carson and Walker Rivers, specifically provides that the commission may permit the direct discharge of domestic sewage or sewage effluent into such rivers subject to such terms and conditions as the commission may impose. There is no provision for review by the courts of the commission's order and no right is given to the affected municipalities to participate as a consultant or otherwise in the decision which may be of vital importance to them. In effect, the final determination, in this regard, of matters of quality and purity of municipal water supplies in the Reno-Sparks Metropolitan area would be taken from City and State officials and would be turned over to the commission.

## No Provision for the Mandatory Replacement of Exported Lake Tahoe Water

Lake Tahoe as a storage reservoir and as the principal source of the Truckee River is subject to vested rights of the United States and of the many thousands of individual,municipal and corporate users from the Truckee River below Lake Tahoe. Under elementary water law each such water user has an interest in the water which drains into Lake Tahoe by natural or artificial means which cannot be taken away except by proper judicial process. Such process would require payment of just compensation, or replacement of the water taken by exchange or otherwise with water of equal quality.

Under the provisions of section I of Article V the commission may at its discretion permit the exportation of waste water from Lake Tahoe upon such conditions as it may impose. There is no provision for the protection of vested rights. We believe that as a condition precedent to an order permitting exportation the commission should be required by specific language in the Compact to impose a condition that the exported water be replaced at a point on the Truckee River above the diversion points of water users who would be affected thereby.

## Certain Delegations of Power Appear to be Unconstitutional

There are several provisions in the draft of Compact which would grant to the commission judicial powers. We believe such provisions violate the basic doctrine of separation of powers, and if included in the Compact as finally approved would be unconstitutional. Some provisions would permit the commission to take private property without due process and without just compensation in violation of the Constitutions of the United States and of the compacting states. Another provision would permit the commission to make future allocations of water to the compacting states without the required consent of Congress.

The specific provisions which we believe must be changed to avoid constitutional conflicts are briefly discussed below.

Section A 4 (d) of Article VI, page 26, authorizes the commission to, in effect, adjudicate certain existing water rights and provides that the determination shall be binding upon both states. It follows that it will be binding on individual owners. There is no right of court review.

Section B 7 of Article VI, page 28, authorizes the commission to make future allocations of unused water without the consent of Congress.

Section C of Article VI, page 29, authorizes the commission to fix the amount of compensation to be paid for water without a right of court review.

Section G of Article V, page 18, would authorize the commission in time of emergency to authorize pumping of water from Lake Tahoe for domestic, municipal and sanitary purposes without provision for payment of just compensation for the property rights taken.

Section A of Article VI, pages 23-26, reshuffles the priorities of private water rights without meeting constitutional due process and just compensation requirements.

## SPECIFIC COMMENTS BY ARTICLE

These comments are directed to the specific articles of primary concern to Washoe County, Reno and Sparks by number, and in the order in which they appear in the printed draft of Compact.

### Article I - Purposes

The Act of Congress consenting to this Compact authorized a compact with respect to the distribution and use of the waters of Lake Tahoe and the Truckee, Carson and Walker Rivers and tributaries of such rivers and lake.

In this article it refers to "basins". A minor change in language is suggested to make this article conform to the wording of the authorizing act.

## Article II - Definitions

Several definitions should be added to this article to avoid misinterpretations and controversies. We suggest adding definitions for such terms as fiscal year, water year, annually, natural flow (which also means direct flow), stream flow, reservoir releases, sewage, sewage effluent, industrial waste, transbasin diversion, ground water, measured, municipal use, domestic use and water user.

Definitions and the use of terms in specific articles should be clarified to be consistent with the definitions in common use for these terms.

## Article III - Sovereign Relationship

This article is not as complete and specific as it should be. It provides that each state will "recognize and accept" water applications of the other but does not provide that the applications will be processed or acted upon. There is no provision requiring the filing of copies of such applications with the Commission.

The policy of interstate cooperation is mentioned in terms so general that it is meaningless. Specific provisions should be added to indicate how such cooperation shall be carried out.

Errors in language appear in the last sentence of section A and section B.

## Article IV - California-Nevada Compact Commission

The word "compact" should be eliminated from the name of the commission. Ordinarily the group which formulates and negotiates a compact is known as a "compact commission" and the word "compact" is dropped from the name of the commission which administers the compact.

The rearrangement of this article and the division into sub-headings is a great improvement. We have no criticism or suggested changes in A and B. With respect to sub-heading C, we believe that it is a serious mistake to give either state the right to refer any question to a board of arbitration for decision and to require a unanimous vote to refer the matter to the federal representative. This procedure greatly weakens the usefulness of the commission and places on three arbitrators, who may or may not have the required background experience and responsibility, the power to make decisions vital to each state. Throughout the compact such highly controversial subjects as water rights, pollution control and exportation of sewage are referred to the commission. It is almost certain that with each state having one vote the vote will be one to one on important questions which will then be referred to a board of arbitration. This solution may not be the panacea it is expected to be. Arbitration is frequently the first step in protracted litigation unless the procedures to be followed are adequately spelled out in the agreement for arbitration. The draft contains no guidelines for arbitration.

Sub-heading D omits the following general powers which we believe are necessary and desirable:

(1) Enter upon or acquire private property whenever necessary for the purpose of this Compact under agreement with the owner thereof or by exercise of the right of eminent domain.

(2) Cooperate with State and Federal Agencies in matters relating to water pollution of interstate significance.

(3) Enforce this Compact and the orders made hereunder by suit or other appropriate action.

(4) Make plans for the coordination of reservoir operations in both states for flood control purposes and to conserve water, and to provide for its maximum use.

(5) Sue and be sued as a legal entity in any court of record of either state, and in any court of the United States having jurisdiction of such action.

Section D6 should be amended by adding the word "pipeline" in line 3 and by changing "require" in line 6 to "order" .

The constitutionality of D9, as written, is doubtful. The key words, "right of access" are so vague that this section is of doubtful usefulness even if it is constitutional.

## Article V - Lake Tahoe Basin

The basic objections to this article are: (1) it does not recognize all of the rights of the United States as set out in claim No. 4 in the Federal Decree and other rights, (2) priority of rights are not specified, (3) the allocation of

34,000 acre-feet annually for diversion and use in the Lake Tahoe Basin is not conditioned on the mandatory construction of the overflow weir at the outlet of the lake within a time limit and on the replacement of that portion of the diverted water not made up by return flow and construction of the weir, (4) the preferential pumping right is an encroachment on the storage right in the lake, (5) the provisions covering the measuring of diversions of water, return flow, sewage and sewage effluent are inadequate and open to controversies as there is no definite requirements for measuring devices such as flow meters in pipelines and weirs in open channels, and (6) the use of the depletion method of measuring return water to the lake is considered impractical as return flow water, with the exception of sewage and sewage effluent, cannot be measured within a reasonable degree of accuracy. Also any credit for depletions resulting from changing irrigated lands to residential and commercial uses, should, in our opinion, be obtained by applications for changes in points of diversion, place and nature of use under the laws of the state in which the changes are to be made. It should be kept in mind that allocating water on the basis of diversions with return flow being recognized as a part of the natural flow of a stream, conforms to other compacts and to the principles of western water law.

Section H, page 19, pertaining to "water quality and clarity," and section I, page 21, pertaining to "permission to export waste waters" should be clarified for meaning, consistency and use of terms. The terms "sewage and industrial waste " and "waste water" are used in sections H and I without definitions in this article or in Article II -"Definitions." These terms should be defined in some instances and words used instead of a term in othe instances. For example, in the first sentence of section I, the term "waste waters" apparently is intended to include only sewage or sewage effluent. Where the terms "sewage" or "industrial waste" are used in section H 3, apparently it is intended to include other substances such as acids, oils or other foreign substances that would adverselv affect water quality – but there is no definition to include these substances.

The completion of the agreement between the United States and the Truckee-Carson Irrigation District would eliminate many of the objections relating to water rights. Also the completion of the agreement between the States of California and Nevada for the construction of the weir would eliminate some of the other objections to this article.

The provisions of this article concerning credit for return flows could be simplified if an agreement could be reached as to the exportation of sewage effluent from Lake Tahoe Basin.

Section H (c) of this article attempts to confer jurisdiction on the United States District Court to enforce the orders of the commission by mandamus and other appropriate remedy. Such jurisdiction can be conferred only by Federal Statute.

See pages 10, 15 and 16 for additional comments on this article.

## Article VI — Truckee River Basin

The interests of Washoe County, Reno and Sparks in the Truckee River (including its tributaries) are two-fold (1) it is the source of water presently used by their residents and (2) it is the most important potential source of supply for future development. The compact should clearly recognize and protect existing water rights and should not prevent, or make more difficult, the new appropriations, changes of use and exchanges of water which will be required for future projects. The present draft falls far short of meeting these requirements for the reasons enumerated below.

A. Existing water rights are not recognized and confirmed. The practice followed in the draft of allocating water to satisfy certain rights relates only to one of some seven elements of a water right. The compact is not definitive as to the remaining elements such as (1) priorities, (2) point of diversion, (3) acreage irrigated, (4) place of use, (5) place of measurement, and (6) rate of diversion.

B. The allocation of 10,000 acre-feet to California is not definite. Section A 3 (a) does not specify whether this allocation is to cover existing rights or "unused water" or both.

C. The order of priorities between the states ignores established priorities among water users. The order established in the draft is as follows:

1. Pyramid Lake Indian Rights.
2. Allocation of 10,000 acre-feet to California.

3. California rights decreed in United States vs. Sierra Valley Water Co.*
4. Nevada rights between Iceland Gage and Nixon as set forth in the 1944 Decree.*
5. Nevada rights for direct use and storage for the Newlands Project.*
6. Nevada storage rights in Donner Lake, Boca Reservoir, Independence Lake and Lake Tahoe.
7. Other existing diversions and uses in Nevada.

It will be noted that the priorities are established not as among the water users but as to allocations set out in the draft of compact. Thus, according to the draft, the judgment in the Sierra Valley case would determine the relative priorities of respective rights. It will be further noted that the Truckee River decree is ignored as a guide for determining the priorities.

D. Subsection A 5 (b) purports to allocate water in accordance with an agreement which has not yet been made. This subsection would further authorize the commission to make an agreement between the United States and the Truckee-Carson Irrigation District unless the contracting parties make the agreement within one year after the effective date of the compact or within extensions of such period. We believe that the attempted allocation to Nevada would fail for uncertainty even if the United States agreed to let the commission make an agreement for it. The probability of acceptance of this provision by the United States if very remote

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* It will be noted that the draft states in A4, pages 24 and 25, with respect to the above priorities 3, 4, and 5 as follows:

> "The relative priority of this allocation and the allocations in Subsection 5(a) and 5(b) (Priorities numbered 4 and 5 above) of this section A shall be in accordance with the priority dates for the respective rights set forth in said judgment." (Judgment in case of United States vs. Sierra Valley Water Company.) Parenthetical statements are added.

E. There is no definite provision for the place of measurement of water. The allocation of 10,000 acre-feet of water to California is to be diverted from streamflow, but nothing is said about where the water is to be measured. Is it to be measured (1) in the storage reservoirs, (2) as it is diverted from a stream,or (3) at the land to be irrigated or at other places of use?

It is provided in subsection A5(e) that the commission shall determine the measuring points for water allocated under subsection A5 and shall locate such points as near the California-Nevada state line as it determines to be practicable. Is it the intent of the compact drafters to have a measuring point for all water decreed by the 1944 decree to Nevada users at or near the state line, and then to divide the water among individual users in accordance with the decree? The draft does not make this clear. In view of the fact that the California uses to the extent of 10,000 acre-feet have a priority ahead of the Nevada allocations under subsection A5(a) and A5(b), and in view of the further fact that there is no allocation in acre-feet or second feet to Nevada it is difficult to see why water should be measured at or near the state line. Subsection A5(e) would just seem to add nothing. There is no provision for measurement of unused water allocated by section B.

F. The term "unused water" is not well defined. It is one which is not commonly used in water law and in the effort to define it two unknowns are referred to, namely, (1) the amounts allocated in section A, and (2) water "which is capable of being developed for use." We think that as the draft is written it cannot be determined how much water is allocated. The largest single diversion will be for the Newlands project and that allocation is not made, but depends upon a future agreement. The demands on the river between Iceland Gage and Nixon are not set out in the draft and no procedure for determining the quantity of water required to satisfy such rights is set out. Indeed, there is no provision as to whether the court or the commission or someone else shall make this determination.

G. The provisions of B(6) through B(8) regarding future allocations of unused water are objectionable because there is no provision for the consent of Congress to any new agreement. A similar, though more definite, provision in the Bear River Compact nearly defeated its approval by Congress. The draft should be amended by inserting appropriate language to require the consent of Congress to any changes in allocations after 1985 as provided in section B6 of Article VI.

H. Section C should be amended by changing the word "right" in line 12 on page 29 to the word "water". This is necessary for clarity and consistency.

I. There are words and phrases which should be defined for purposes of clarity. These include "New storage capacity" in subsection B page 27, lines 1 and 2, and "deplete" in B page 27, line 15.

J. Section C, as written, is considered unconstitutional because it authorizes the commission to determine the amount of compensation to be paid for water taken. We believe the fixing of compensation by an administrative body without a right to court review contravenes the due process clause of the Constitution of the United States.

## Article VII - Carson River Basin

It is considered that Washoe County, Reno and Sparks have an indirect interest in this article because of (1) the interconnection of water rights and administration of the Carson River with the Truckee River and Lake Tahoe, and (2) the effect that the proposed Watasheamu or other potential reservoirs would have in lessening future water demands on the Truckee River.

A stipulation that will satisfy existing rights and at the same time leave sufficient unappropriated water to justify the proposed Watasheamu Reservoir and other reservoirs will greatly simplify this article and future water distribution on the Carson River and its tributaries. It would also help clarify water rights and operation of the Truckee River and Lake Tahoe.

Consideration of this article has been confined to the proposed stipulation.

## Article VIII - Walker River Basin

An analysis of this article as now written has not been made since Washoe County, Reno and Sparks have no direct interst in the water rights of the Walker River.

## Article IX - Ground Water and Springs

The present language in this article would impose too much of a burden on the commission. The commission should act only in case of interstate violations and then only upon the complaint of the aggrieved state. Also see page 12.

## Article X - Interbasin Transfers of Use

The language in this article is too broad. It does not, by reference to state law or otherwise, protect existing rights which may be adversely affected by changes of place of use whether interbasin changes or otherwise. Also see page 13.

## Article XI - Suppression of Evaporation

This article as written is a weak statement of policy that could cause a conflict between the jurisdiction of the State Water Administrators and the Commission over water savings as previously explained on page 13. In our opinion this article should be eliminated as either state is already entitled to participate in an evaporation suppression project without the compact. The division of the water saved in any "project" would necessarily be spelled out in each specific agreement for a project. Also, it is doubtful that the language of the second sentence of section A would be approved by Congress because it would provide for future allocation of water by the commission without the consent of Congress. The language should be revised if the article is to remain in the compact.

## Article XII - Coordination of Reservoirs

Consideration should be given to the elimination of this article and including its substance among the powers of the commission. The only purpose of the article, as written, is to authorize the commission to make plans for the most efficient method of reservoir operation. This would entail the coordination of storage and releases that could not be accomplished without agreement with the reservoir owners and operators. It will be noted that the article does not purport to authorize the commission to carry out the plans - which it could not do without running afowl of the Constitution. The most the commission could do is to plan, suggest and encourage coordination of storage and releases of water as a conservation measure. This authority could be included by adding an appropriate sentence in the "powers of the commission."

## Article XIII - Fish, Wildlife and Recreation

We have no objection to this article. However, the language should be rearranged for the purpose of more accurately expressing the thought. The wording "preservation and protection and enhancement" should apply only to fish and wildlife.

## Article XIV - Nonconsumptive Use

For comments on this article see page 14.

## Article XV - Diversion and Exchange of Yield from Future Reservoirs

The present language in this article requires approval by the commission of exchanges of allocated unused water wholly within a state as well as interstate exchanges. This would conflict with basic state law. The language should therefore be re-written to confine the jurisdiction of the commission to interstate exchanges of water.

## Article XVI - River Water Quality

See page 15 for a discussion of this article under the heading, "Recourse to the Courts to Enjoin Water Pollution in Another State is Denied." The order of the sentences in this article should be rearranged to make clear that the commission has authority to establish standards of quality pertaining to all harmful substances. Instead of using the ambiguous word "waste," the words sewage, sewage treatment plant effluent, acids, oils or other foreign substances are suggested.

Attention is called to section B which makes the procedural provisions of subsection H 3 of Article V applicable to this article. It is again pointed out that two states cannot by compact confer jurisdiction on a federal court to hear a petition of the commission for enforcement of its orders.

## Article XVII - Change in Point of Diversion, Manner or Place of Use

Our basic objections to this article are that it does not completely state the procedure to be followed to obtain a permit for change of use and it contains no provision for the protection of existing water rights. In the third sentence it is provided that it shall be the duty of the state to initiate proceedings before the commission if it believes that such change in the other state would adversely affect its allocation. We take it to mean that if a change is applied for in California which adversely affects a water right in Nevada it would be up to Nevada to initiate proceedings before the commission. As a practical matter, how will Nevada know about applications filed in California? There should be some provision for notice of applications filed in the other state.

## Article XVIII - Imported Water

This article is not clear as to what is intended. As written the article would cover importations of water and its use wholly within a state or it could cover importations from one state for use in the other state. The article should therefore be revised to cover only importations and use of water of interstate significance.

## Article XIX - Compact Effect

We believe this article is unnecessary as it is merely a statement of law.

## Article XX - Violations

The language of section A may infer that jurisdiction is conferred on a United States District Court to act on violations in its district. Such jurisdiction cannot be so conferred.

We believe that section C should be re-written to make it clear that the compact does not deny to any state, municipality, corporation or person the right of recourse to the courts for the protection of property, nor deny the right to judicial review of any order, decision or other action of the commission.

## Article XXI - Non-impairment of Rights of United States

The exception in the first line of this article is a departure from presidential directives and established policy. See the discussion under the heading "Provisions Binding United States Conflict with Established Policy," beginning at page 3.

## Article XXII - Ratification and Consent

See the discussion under the heading mentioned in our comments on Article XXI.

## Article XXIII - Termination

No objection.

## CONCLUSIONS AND RECOMMENDATIONS

It appears to us that most of the objections specified in detail in this document stem from the efforts of the drafters to use the compact as a means of limiting the rights and restricting the authority of the United States in and over the waters of Lake Tahoe and the Truckee and Carson Rivers. Much of the basic uncertainty in the compact with regard to existing water rights and water administration can be avoided if the United States and the Truckee-Carson Irrigation District enter into an agreement limiting acreage and otherwise defining water rights on the Newlands project in advance of the compact, and if the parties stipulate a decree on the Carson River.

We recommend that the preparation of a final draft await the resolution of these problems involving the United States, and that in the meantime a sustained and aggressive effort be made to complete the necessary agreements.

Respectively submitted:

E. O. Larson
E. O. Larson

E. J. Skeen
E. J. Skeen

## APPENDIX G

## THE DRAFT CALIFORNIA-NEVADA COMPACT: COMMENTS OF THE DEPARTMENT OF THE INTERIOR

The Department of the Interior has been asked to comment on the draft compact between the States of California and Nevada, as provisionally approved by the Joint Compact Commission on October 29, 1965.

The desire of the drafters to make certain that all relevant State rights are appropriately recognized in the Compact is proper and appropriate. At the same time, it is important that the compact, as an agreement between two States, fully recognize the rights and status of the Federal Government and the rights of the Indians. There appear to be areas in which the language of the draft compact fails to fully recognize those rights.

Our principal objection to this compact, as it is presently drafted, is that it purports to bind the Federal Government in its use of interstate waters, both as a sovereign and as trustee for the Pyramid Lake Indians. Paragraph (3) of Article XXII of the compact provides, among other things, that the compact shall become effective only when Congress has agreed that certain provisions of the compact "shall be binding on the agencies, wards, and instrumentalities of the United States of America." This is the first time to our knowledge that it has been proposed that the United States should be bound in such a fashion by an interstate compact. We feel strongly that this type of provision is undesirable and should be eliminated before the compact is consented to by the United States.

Language similar to this did appear in Articles XI and XIII of the Klamath River Basin Compact of 1957 (P. L. 85-222), but that legislation also contained general language as to the reserved constitutional powers of the United States. It is our feeling that the acquired right to the use of the water by the United States should no more be subject to the police powers of the States than is the acquired right to the use of any other property by the United States.

Consistent with this basic objection, we recommend that paragraph (3) of Article XXII be deleted. Further we feel that the compact should be amended to make it quite clear that it will in no case have the effect of derogating from established Federal or Indian rights. To this end we recommend that the following changes be made:

(a) Delete the phrase in Article XXI "except as provided in Article XXII";

(b) Add the following language to Section A of Article XXI:

> "including any right established or asserted and any right which may be established or asserted in the future."

(c) Add a new paragraph (e) to Article XXI:

> "Any reference herein to any rights of the United States or of the Indians, presently established or asserted, is for reference only, and shall not in any way affect the rights stated."

The effect of these changes will be to make it abundantly clear that this compact will in no way interfere with existing rights of the United States or of its Indian wards which might otherwise have been adversely affected by this compact.

In addition to the fundamental objection stated above, we recommend that certain other changes be made in the compact. Some of these relate directly or indirectly to the foregoing objections:

(1) The foreword should set out the consent statute authorizing the negotiations for the compact -- the Act of August 11, 1955 (69 Stat. 675).

(2) Article II, D. The term "Truckee River Basin" should include "Pyramid Lake." It is our understanding that the physical basin in fact included Pyramid Lake. This addition will eliminate an uncertainty.

(3) Article II, F. The term "Walker River Basin" should include "Walker Lake." It is our understanding that the physical basin in fact includes Walker Lake. This addition will eliminate an uncertainty.

(4) Article II. It would be appropriate and helpful if there were attached to the compact as an appendix a map showing the separate stream systems, major tributaries, and basin boundaries as defined therein.

(5) Article II, G. The date "1964" should be stated as "December 31, 1964" for completeness.

(6) Article II, C. The use of water by the United States of America under certain conditions, such as fulfillment of rights claimed by the Indians, should be stated as a claim on the interstate stream system and not as a claim charged to the State in which the use is made by the United States.

(7) Article IV, A. The composition of the Commission in each State differs inasmuch as the Nevada Commission establishes geographical membership with certain qualifications placed upon the individual members to be appointed, whereas the California Commission is left solely to the discretion of the Governor, limited only in that they shall be residents of the State of California. While this is not fatal, it appears to lack consistency and the nature of the qualifications for the Nevada Commission might tend unduly to emphasize one area or type of use over another.

(8) Article IVD(9). This section could cause difficulties for the proper Federal management of wildlife refuges. It is suggested that the first line of this section be revised to read "Obtain a right of access to all private properties (other than Indian) in the . . . ."

(9) Article V, B. It is suggested that a proviso be added to the end of the first sentence as follows: "And Provided Further, That the weir and necessary channel improvements must be constructed before the water surface of Lake Tahoe is drawn below elevation 6225 Lake Tahoe datum."

(10) Article V, D. The Department of the Interior has concern about the allocation of 34,000 acre-feet of gross diversion conditional upon construction of the overflow weir and therefore suggests that Section D be modified as follows:

Revise the second sentence of the Section to read:

"This allocation is conditioned upon the construction of the overflow weir and necessary channel improvements prior to drawdown of Lake Tahoe below elevation 6225. Recognizing that there may well be a period of time between the effective data of the Compact and construction of the overflow weir and necessary channel improvements, both States shall be permitted to use water within the Lake Tahoe Basin during this period of time subject to the same conditions both as to place of use and amounts of use as are provided in this Article V.

"It shall be the duty of the Commission as soon as practicable following its organization to determine the amounts of such diversions and use within the Lake Tahoe Basin. Such determinations by the Commission shall be maintained on a current basis thereafter, and shall be binding on both States."

(11) Article V, E(3). This Article will require continuing water use studies in the Lake Tahoe Basin. The Department of the Interior has recommended that because of its obligations to maintain the Newlands and Washoe Projects the second sentence of the paragraph be revised to read as follows:

"If the Commission determines and if the United States concurs in this determination that allocation on net depletion basis can be measured, that method of allocation as hereinafter outlined shall be employed, provided the diversion weir and the channel improvements specified in Section B of Article V have been constructed."

(12) Article V, E(5). This Article appears to be ambiguous and to take credit twice for the anticipated 7,500 acre-feet yield of the project overflow weir. It is suggested that this ambiguity would be removed by deleting in the eighth and ninth lines the words "after installation of said overflow weir and."

(13) Article V, G. This permits pumping from Lake Tahoe for certain specified purposes in the event of an emergency. The volume pumped will undoubtedly be small, but it is unclear as to whether this is intended to cover pumping downstream within what is defined as the Lake Tahoe Basin. It is therefore suggested that the word "Basin" be added following the words "Lake Tahoe." This Article is also subject to the so-called Truckee River agreement, and inasmuch as that agreement is not referred to it would appear appropriate that some definition or reference be made to the agreement at this point.

(14) Article V, H(1). It is recommended that the words "fishery resources" be modified to read "fish and wildlife resources."

(15) Article V, H(2). The phrase "domestic sewage or sewage-plant effluents" does not appear adequate. It is suggested that this be expanded to read "the direct discharge of domestic sewage, sewage-plant effluents, industrial refuse, or other wastes into Lake Tahoe or tributary streams is prohibited:...."

(16) Article V, I(2) In line 12 the word "or" should read "of".

(17) Article V, I(3). This Article is intended to prevent reduction of any diversion and use of water from the Tahoe River due to the export of "waste water" from the Lake Tahoe Basin. It should be revised to limit the Commission's authority to the approval of the exportation of "waste water."

(18) Article VI, A(2). This section should be deleted inasmuch as it appears to provide what the United States may be granted by Court Order as well as to deal generally with the question of United States and Indian rights--a matter not within the scope of the Compact.

(19) Article VI, A(3)(a). It is understood that the 10,000 acre-feet allocation to California for the most part covers present diversions, and uses under existing rights. This provision also appears to provide that the overall amount shall include any rediversions of

return flows usually not accounted for separately under California appropriations. To clarify this, it is suggested that the following be substituted for sub-article (a).

> "There is allocated to California the right to divert from stream flow for use within the Truckee River Basin in California, a maximum of 10,000 acre-feet per year, provided that any rediversion of return flows shall be deemed to be a diversion of natural stream flows."

(20) Article VI, A(5)(a). The reference to "Nixon" does not find support in the 1944 Truckee River decree. It is, therefore, suggested that the first part of this subparagraph (a) be revised to read as follows:

> "There is allocated to Nevada water to satisfy all rights to divert and use water from the Truckee River below Iceland Gage as set forth in the 1944 Truckee River Decree, * * *."

(21) Article VI, A5(b) It is suggested that the language following the words "Lahontan Reservoir for later use" be stricken and replaced by "under authority of the United States."

(22) Article VI, A5(b), (i) and (ii). Subsections (i) and (ii) should be deleted. The rights of the United States should not be limited by any authority of the Commission. No reference is appropriate here to the proposed settlement between the United States and the Truckee Carson Irrigation District.

(23) Article VI, B This subarticle attempts to define and allocate certain storage rights of the United States in Stampede Reservoir It further attempts to establish the principle that "unused water" means all water over and above existing uses or properly authorized Federal uses. This approach to allocation of water between States is not in accordance with compact standards currently used elsewhere It places in jeopardy any rights decreed to the United States or any rights the United States might have under permits or other determinations if the Commission found such rights not synonymous with "existing uses." Thus, insofar as the rights of the United States are concerned, decreed or other water rights held by the United States should be recognized to their fullest extent of such rights and should not be limited by any determination of the Commission as to their existing uses. Thus, the United States is constrained to object to all of Article VI, B, as presently drafted, unless agreement can be reached on a more appropriate definition of "unused water", as discussed in the next paragraph.

(24) Article VI, B(2). This is ambiguous as to the allocation of water in connection with Stampede Reservoir. The allocation of the yield should be 30/155 to California and 125/155 to Nevada. That would allow for Stampede's present estimated capacity of 225,000 acre-feet, as opposed to the limit of 155,000 acre-feet indicated in the

Compact. To accomplish this, and assuming that an appropriately limited definition of the term "unused water" can be agreed upon--and from the standpoint of the United States the term "unused water' would have to be defined so as to be close to, or approximate "unappropriated water"--it is suggested that Article VI, B(2) be revised to read as follows:

> "The yield from unused water (as defined above) which is stored in the first 155,000 acre-feet of new storage capacity is allocated 30/155 to California and 125/155 to Nevada with equal priorities. The term 'yield,' as used in this paragraph, is the annual water quantity available for use that can be sustained indefinitely from unused water and the storage of unused water. This provision does not imply, nor is there, any agreement on the part of the United States to operate the Federal Reservoir in accordance with terms and conditions imposed by the State agency."

(25) Article VI, B(3) This should be revised to read as follows:

> "From the remaining unused water, there is recognized the right to store in Prosser Creek Reservoir a maximum of 30 000 acre-feet of water annually and to operate the reservoir as set forth in the Federal authorization and any future modification."

(26) Article VI, B(5). Administration of this subsection is of particular concern to the United States in maintaining the Newlands and Washoe Reclamation Projects. It is, therefore, suggested that it be revised to add a subsection (c) requiring that actions taken under Article VI, B(5)(b) be appropriately coordinated with the requirements of the United States for the operation of Newlands and Washoe Projects.

(27) Article VI, C. This Article should be revised so as to take into account certain necessary releases for fish, wildlife, and recreational purposes. Accordingly, the following revision is recommended for the first sentence of the subsection:

> "C. To the extent that the water allocated above in this Article is used for power generation on the Truckee River and is not used in the Truckee or Carson River Basins for irrigation, municipal, industrial, or domestic use, and is not specifically used for fish , wildlife, or recreation use in the Truckee River Basin upstream from Pyramid Lake, but can be diverted upstream from the powerplants or stored for irrigation, municipal, industrial, domestic, or fish, wildlife, or recreational purposes, it shall be regarded as 'unused water' and the corpus of such water, as distinguished from the water right, shall be allocated upon a

year-to-year basis in accordance with the provisions of subsection B(4) of this Article."

(28) Article VII, A(1). Inasmuch as a final decree has not been entered in the case of United States v. Alpine Land and Reservoir Co., it is not possible to estimate this allocation. In this connection the proposed stipulation set forth as Appendix A that the Alpine case is an interstate adjudication. Inasmuch as the waters of the Carson River in both the States of California and Nevada are being adjudicated, drastic revision of the Carson River allocation might be made following entry of the final decree. It is therefore impossible at this time to evaluate properly these allocations pending the outcome of the litigation.

The comments set forth above for Article VII, Subsection A(1), also apply to subsection A(2), and to subsections B, C, D, and E.

Again, the same objections to the application of the unused water concept on the Truckee River apply here to the Carson River. This is a similar attempt to determine by Compact all existing uses and to allocate all water over and above such existing uses. This puts in jeopardy decreed rights as they may be determined in the Alpine case and threatens the contract commitments of the United States with the water users under the Newlands Project.

(29) Article VII, H. This Article is not acceptable in that it seeks to place with the Commission the authority to make a settlement between the United States and the Truckee Carson Irrigation District with respect to certain water sought for the District's use. These are matters outside of the scope of the Compact.

(30) Article VII, J. Consistent with the previous comment on the similar provisions of Article VI, C, revision of the first sentence is recommended as follows:

> "To the extent that water allocated above in this Article is used for power generation downstream from Lahontan Dam and is not used for irrigation, municipal, industrial, or domestic use and also is not used for upstream fish conservation, wildlife, or recreation use, but can be diverted upstream from the powerplants or stored for irrigation, municipal, industrial, domestic, or fish, wildlife, or recreation purposes, it shall be regarded as unused water and the corpus of such water as distinguished from the water right shall be allocated upon a year-to-year basis in accordance with the provision of section N of this Article."

(31) Article VII, K. This Article should be revised to take into account holdover water which is chargeable to allowable storage.

(32) Article VII, M. Attempts to define "unused water." See comment (25) on Article VI, B.

(33) Article VII, N. The allocation percentages used herein (20 percent to California and 80 percent to Nevada) are not consistent with the Washoe Project contract provisions which allocate 15 percent to California and 85 percent to Nevada. Therefore, the Article should be revised to exclude from the 20-percent allocation to California, water covered by existing contract provisions, and to define this as a purpose for overall development.

(34) Article VII, P. This Article should be deleted in light of previous comment on Article VII, A(1).

(35) Article VIII. This Article is objectionable in light of the previous comments with relation to any attempt to limit Indian rights to those presently decreed. It is suggested that revision of this Article should be done consistent with the comments relating to the revisions necessary to exclude from the Compact present and future rights of the United States including those of the Indians.

(36) Article VIII, B. This also attempts to define "unused water" as that available for allocation over and above existing use. Our previous comments with relation to this, also apply here to the Walker River.

(37) Article XVI, A. A reference should be included to the Water Quality Act of 1965, as amended (79 Stat. 903), and to any agreement by California and Nevada to comply with its provisions.

(38) The first part of Article XXI, B, should read: "Affecting any rights, uses, or powers of the United States . . . ." This will assure protection for United States uses of water as at the Stillwater Wildlife Management area whose water is used for fish, wildlife, recreation, and associated pasture benefits.

(39) To provide proper continuity, Article XXXIII should precede Article XXII.

(40) Article VII, B(1), B(2), and B(3), relating to rotation provisions for using Carson River water in California and Nevada is generally in accord with present operations, and so no revision is suggested.

(41) Article IV, E. The authority of Commission to exercise the powers here stated during an emergency is not objectionable as other revisions will provide for removal of United States rights from Commission jurisdiction.

(42) Articles VI, B(1); VII, M; and VIII, B(1) are inconsistent in their definitions of "unused waters". However, the comments made above seek a redefinition of "unused water," and so this inconsistency is unimportant.

(43) Article VIII. The Indian rights on the Walker River are primary rights, and so no modification of language is needed as to those rights, if the compact is revised to be inapplicable to Indian rights.

## APPENDIX H-1

## ADDITIONAL STATEMENT BY REGION 2, U. S. BUREAU OF RECLAMATION

In stating that the Bureau of Reclamation has no direct responsibility relating to pollution problems of Lake Tahoe, we were referring to the enforcement aspects which were the subject of the Lake Tahoe Conference. From the standpoint of the overall program of water quality and pollution control, the Bureau of Reclamation does have a definite responsibility. The Secretary of the Interior has approved an aggressive anti-pollution program under which the Bureau of Reclamation will increase its water quality improvement and control efforts in water courses, reservoirs, and irrigation systems throughout the western United States. Under this program, the Bureau of Reclamation is moving ahead vigorously to fully consider water quality in our project planning, to eliminate pollution, and to maintain the quality of water to the maximum extent through operation of project facilities. Consistent with this program in developing plans to meet future water needs, the Bureau of Reclamation will give consideration to the possible need for water to replace exported sewage and, of course, desires to assist in any other possible way to maintain the unique beauty of Lake Tahoe.

to the main U. S. 50 highway and wasn't considered to be a part of this public hearing.

MR. ZAPPETTINI: I am George Zappettini, state forestry, Carson City. I would just like to echo a little of what Mr. Abbott had to say, that a greater consideration be given to the watershed aspects of this project. No matter how much you try to minimize it, the highway is going to create a huge scar, a scar that will need attention, replanting. So I would like to suggest to the Highway Department that some watershed specialist be employed, some hydrologist, and more attention given to that area.

And as to the beautification, I think you covered that part, Mr. Fodrin, that the banks and the cuts and the fill would be planted to grass and shrubs. Is that right?

MR. FORDRIN: Right.

MR. ZEPPETTINI: That is all I had. Thank you.

MR. WALKER: Thank you, George. Mr. Irving Terzich, Federal Water Pollution Control Administration.

MR. TERZICH: Thank you very much, Mr. Chairman. My name is Irving Terzich, sanitary engineer, Federal Water Pollution Control Administration, southwest region, San Francisco.

I do not have a prepared statement, however, I would like to make a few comments for the record.

The Federal Water Pollution Control Administration and the states of California and Nevada will be particularly interested in the alignment of this freeway. On July 18th and 19th of this year, 1966, an official Federal Water Pollution Control conference was held at Stateline concerning all types of land and water uses.

I would like to read into the record two items upon which the conferees agreed. Item No. 4, and I quote: "Basinwide objectives and standards for development and use of the lands and waters must be established within a framework which includes positive enforcement provisions, covering not only the waters of Lake Tahoe but its shoreline development and the total complex of land and waters that make up the basin."

Item No. 10, and I quote again: "All federal, state and local agencies shall perform their functions in such a manner as to permit land development in the Lake Tahoe Basin to proceed without threat to the high quality of Lake Tahoe waters."

Although we are specifically interested in water pollution, not only in the public health aspects, under our Federal Act we are also interested in those other beneficial uses that might be involved, and alluded to by Mr. Abbott. One of these is the aesthetics of the area.

We will be specifically interested, through our relationship with the Bureau of Public Roads, United States Department of Commerce, because federal funds will probably be involved in the construction of this highway route, freeway route, in the control of erosion, possible soil and silt transport by natural waterways into Lake Tahoe, but not only that, into the streams that would be flowing through this. Here the beneficial uses that might be involved would be aquatic and fish life in the streams, siltation from the aesthetic standpoint of the Lake, in the Lake, and the affect of the aquatic environment in the Lake.

We are in close consultation with the San Francisco office of the Bureau of Public Roads. Recently they have received information and resolutions from their federal highway administrator which sets up very specific methods on control through contractual arrangements with the state highway commissions and contractors on specific projects for the institution of water pollution control facilities in highway construction.

Thank you very much.

MR. WALKER: Thank you very much, Mr. Terzich.

Mr. Watson Ellis of Zephry Cove, Nevada, has a note: "A written statement will be submitted at a later date."

This probably won't be in the official record of the public hearing. Would Mr. Ellis wish to say anything at all?

MR. ELLIS: Not at this time, Mr. Walker. Thank you.

MR. WALKER: Thank you. Mr. Art Suverkcup has

# APPENDIX H-2

# STATEMENT OF THE BUREAU OF SPORT FISHERIES AND WILDLIFE

# DEPARTMENT OF THE INTERIOR

# PORTLAND, OREGON

The Lake Tahoe Basin in California and Nevada is one of the outstanding recreational areas in the United States, and its recreation based economy is expanding significantly. The peak summer season population was about 180,000 in 1965, and is expected to exceed one-half million in 50 years.

Lake Tahoe is the major attraction of the Basin. It has great natural beauty in its mountain environment, and esthetic and recreational values of the lake are of national significance. It is one of the largest and deepest Alpine lakes in the world, having a surface area of 190 square miles and a maximum depth of 1,645 feet. The lake is unique and widely known for the extreme clarity of its waters with known depth visibilities of well over 100 feet.

Fish resources of Lake Tahoe are a major element of recreational attraction of the area. Within historical time, the lake supported a highly prolific fishery of commercial proportions for native cutthroat trout, rainbow trout, and mountain whitefish. Fish species which have been introduced into the lake between 1870 and recent times include Atlantic, chinook, coho, kokanee, and salmon; rainbow, brown, brook, and lake trout; and lake whitefish. Although numbers of native and introduced fish have declined over the years, and various species have disappeared, the present-day sport fishery is of considerable importance, particularly for lake trout and rainbow trout. The California and

Nevada Fish and Game agencies conduct continuing programs of fishery research and management at Lake Tahoe to maintain a quality sport fishery as a leading element of the natural resource assets of the lake. The value of the Lake Tahoe sport fishery stems from its role as an integral part of all of the unique natural resource aspects involved. The value is not mainly dependent on the attainment of maximum possible fishery production or angler catches, per se to the exclusion of other recreational or esthetic values. The attractiveness of the Tahoe fishery is inextricably linked with the attractiveness of the lake. In this regard, any destruction of the natural beauty of the lake would detract from a rare quality fishery and result in a less desirable fishery. The Bureau of Sport Fisheries and Wildlife is gravely concerned over the threat of accelerated eutrophication within Lake Tahoe that would result with introduction of heavy loads of sewage and silt. Chemical and biological changes to be expected with continued high-level water pollution would ultimately destroy the existing natural values of the lake and the associated fishery.

We are gratified that the threat of water pollution in Lake Tahoe has become a subject of wide-spread concern, and that planning for effective control measures is now in progress by the States of California and Nevada and the Federal Government. The unique values of Lake Tahoe may thus be protected. This Bureau fully endorses water-quality control for Lake Tahoe and pledges full cooperation in any program devoted to that end.

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Statement of Frank E. Sylvester, Regional Director, Bureau of Outdoor Recreation, Department of the Interior, San Francisco, California, on the Recreational Aspects of the Lake Tahoe Basin for inclusion in the record of the Enforcement Conference on Interstate Waters of Lake Tahoe, July 18-19, 1966.

This statement was also presented to the House Committee on Public Works, April 30, 1966.

Public Law 88-29 assigned to the Secretary of the Interior and this Bureau the responsibility to coordinate the plans and programs of all agencies involved in outdoor recreation throughout the Nation. Specifically, this was done to effectively meet the present and future recreation demands with quality recreation areas. In carrying out this responsibility, the Bureau advocates the retention of the natural beauty of this country in relation to the recreation purposes it can serve.

The outstanding park and recreational values of the Lake Tahoe area have been recognized for many years. Joseph Knowland, as far back as 1912, introduced a bill in the Congress to establish a National Park at Lake Tahoe. The bill compared the basin's quality and desirability to Yellowstone and Yosemite. This action was prior to the establishment of the National Park Service.

For some time now, we have been aware of the impending pollution problem in Lake Tahoe. Basically, this problem is one of trying to maintain wilderness quality water in a non-wilderness environment.

The scenic quality and location of Lake Tahoe, however, are unfortunately bringing about the area's deterioration. Also, I am reluctant to say, the recreation industry spawned by this beautiful basin is the biggest culprit in creating this destruction. The dark blue water, ringed with forested shores, is the central attraction of a thriving recreation mecca. This, coupled with ready access, has subsequently increased the resident and visitor population of the basin. Recreation has become both the primary asset of the area and indirectly the largest detriment to the Lake's natural characteristics.

When I mention recreation at this point, I am not thinking only of outdoor recreation. The very thing which makes the Tahoe area attractive is its ability to play host to a broad range of recreation activities - both indoor activities as well as outdoor. An added quality of recreation desirability is the area's capacity to provide year-round recreation opportunities.

The basin is surrounded by a wealth or winter sports areas, golf courses, campgrounds, boating facilities, and beaches, to mention but a few. In fact, all of the 20-odd outdoor recreation activities listed in the 1962 Outdoor Recreation Resources Review Commission Report -- from driving for pleasure to snow skiing -- can be enjoyed here.

Recreationally speaking, we cannot deny the impact that the gaming industry has on the area. This diversion, besides being an attraction in its own right, provides supplementary recreation for the outdoor enthusiast.

In addition to the basin-supported recreation facilities, the area serves as a base camp for interesting side trips to the surrounding mountain and desert attractions of California and Nevada.

The "Comprehensive Study on Protection of Water Resources of Lake Tahoe Basin Through Controlled Waste Disposal" was published in 1963 and financed by the Max C. Fleischmann Foundation. Its opening paragraph says of the Tahoe basin: "It lies within a four hour drive of some three million people and scarcely more than one day's drive of nearly 10 percent of the total population of the United States." This was written three years ago and in the interim the Western States have led the population boom.

We cannot be specific in determining what the actual recreational participation within the basin is now or will be for the future. No complete basin-wide studies on recreation have been undertaken. We assume, however, that the demand will be overwhelming. One study for Lake Tahoe indicates that by 1980 the peak summer month (August) the population in the basin will reach 402,000. In 1962 these figures were 132,000 total. The main source of visitors is northern California, with southern California and Nevada following closely. The existing and potential recreation demand at Lake Tahoe is of priority attention at the Federal, State, and county levels. All existing criteria for recreational investment and development stress the fact that the Lake Tahoe Basin should receive primary consideration.

On the Federal level, recreational investment policy is set forth in the President's Recreation Advisory Council Circular No. 5. This States, in part, "Primary priority for outdoor recreation investment normally shall be assigned to projects which are:

> (a) Located near (within approximately three hours automobile travel distance) urbanized areas. . .

(b) To be acquired and developed in conjunction with water bodies (reservoirs, natural lakes, seashores, and rivers).

Federal interest in the recreation quality of Lake Tahoe was recently expressed through one of the initial land acquisition grants from the Land and Water Conservation Fund. In addition to supplying $500.000 to the State of Nevada from regular State apportionment, the Secretary of the Interior authorized the $1-1/2 million more from that portion of the Fund set aside for high priority projects where sufficient monies are not otherwise available. These $2 million, matched by the State and the Max Fleischmann Foundation, will be used to acquire 12,000 acres adjacent to Lake Tahoe for State Park purposes. This will include approximately 7.5 miles of Lake Tahoe shoreline.

The State of Nevada, in its outdoor recreation plan, Recreation in Nevada, places the acquisition of public recreation lands at Lake Tahoe as the highest priority in the State. To accomplish this end, negotiation for the purchase of the 12,000 acres previously mentioned is now under way.

The State of California also is guided in its recreation development by a Statewide comprehensive outdoor recreation plan. The revised edition of their plan, entitled California Recreation and Park Study, is to be released shortly. All priority criteria within the plan indicate that recreation areas, such as Lake Tahoe, be given immediate development attention to maintain equality between supply and demand.

At present, the State of California maintains four park units along the Lake totaling 3,535 acres, with 9-3/4 miles of shoreline. In addition, the State has authorized the establishment of a State park at Sugar Pine Point, which will include approximately 1.5 miles of shoreline. These, together with the 7.5 miles of shoreline proposed for acquisition by Nevada and various small county beaches indicate an encouraging aspect for public recreation facilities. The success of these efforts, however, is based largely on relating the scenic and other qualities of Lake Tahoe itself and its surrounding environment.

Private recreation enterprise also is playing a key role in providing recreation facilities in the basin. The ski resorts, the group camps, and other supportive facilities furnished by the private sector all contribute significantly. The far-reaching developments of the private recreation suppliers must be effectively planned for and encouraged, if Lake Tahoe is to continue to be recreationally speaking, the "Gem of the Sierra Nevada's." This factor is substantiated in the preliminary regional plan for Lake Tahoe prepared for the Tahoe Regional Planning Commission of California and Nevada. It states: "The total volume of presently undeveloped private land is more than sufficient to accommodate the growth in population and tourist activity throughout the planning period to 1980." Here, again, though, anticipated growth will be dependent largely on retaining the overall scenic quality of the Lake and its surroundings.

Lake Tahoe should be associated with the words "quality recreation" much more so than "quantity recreation". It has a combination of natural beauty and pristine water rarely found in the world.

In carrying out the Bureau's role of coordinator of recreation plans and programs, it is our task to prevent incompatible encroachment on natural beauty occurring from recreational development. These efforts are in accord with the objectives spelled out by President Johnson in February 1965 in his Message on Natural Beauty of Our Country. Within our scope of operations, we are striving to prevent pollution in line with the objectives outlined by the President in his February 1966 Message on Preserving our Natural Heritage. The President's Recreation Advisory Council, in its Circular No. 3, sets forth policy governing the Water Pollution and Public Health Aspects of Outdoor Recreation. This serves as a policy for Federal recreation agencies and a guideline for State and local agencies. The purpose of this policy is twofold: (1) to prevent and control future water pollution and to restore existing bodies of polluted water to the highest quality practicable, and (2) to govern the planning provision and maintenance of sanitary facilities at outdoor recreation areas.

In summary, we feel the important outdoor recreation resources of the Lake Tahoe basin are largely dependent on maintaining the high scenic quality and purity of Lake Tahoe itself. To maintain these conditions, it is imperative that Federal, State, and local agencies and private endeavors be coordinated and be substantial. The Bureau of Outdoor Recreation stands ready to assist in every way possible.

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APPENDIX H-4

## LAKE TAHOE WATER POLLUTION ENFORCEMENT CONFERENCE - July 18-20, 1966

### DEPARTMENT OF AGRICULTURE
Statement of Soil Conservation Service

Reno, Nevada July 19, 1966

The Soil Conservation Service is concerned with the problems involved in the conservation of soil, water, and plant resources as it affects the quantity and quality of the waters of Lake Tahoe for recreational use as well as downstream uses for urban, industrial, and agricultural purposes.

An important problem is involved in the use of fragile soils of the mountainous borders of the Tahoe Basin and the bottomlands adjacent to the shoreline of Lake Tahoe. Carson Range, for example, with its crest mostly above 8,000 feet elevation, forms a portion of the watershed boundary between Lake Tahoe and the Carson River drainage system. It exhibits considerable relief and is mantled by soils formed from granites and metamorphic rocks which have a severe erosion potential. The vegetative cover throughout most of Carson Range and along the shore of Lake Tahoe is mixed conifer forest which appears to be best adapted to the soils. When the cover is destroyed or removed, serious erosion with accompanying floods and sediment result.

Shifts in land use will aggravate this problem. Major uses such as forestry, watersheds, wildlife, and grazing are being replaced to a considerable extent by urban and recreational oriented activities and related developments. Such shifts in land use may seriously affect the present hydrology of the watershed and result in erosion of the soil resource and the contribution of sediment to Lake Tahoe and shoreline developments and accelerated eutrophication.

Sound planning based upon knowledge of the kinds of soil, plant and wildlife resources, and hydrologic characteristics is needed for orderly future development to avoid the serious consequences of disrupting the hydrology of the watershed.

Modern surveys capable of supplying such data are lacking and it is not realistic to assume that adequate planning and development may proceed without such information.

We recommend as a high priority that responsible organizations secure soil and vegetative surveys upon which comprehensive planning may be based. Such surveys should be designed to provide essential data and interpretations for (1) planning urbanizations; (2) planning the locations of recreational oriented industrial developments; (3) planning the location of streets and roads; (4) establishing sanitary regulations; (5) maintaining aesthetic values and providing for such needs as road beautification, park planning, etc., and (6) projecting needs for watershed and flood protection works that may become critical with continued development and changes in land use within the basin.

We feel it imperative that fully adequate and reliable information on soil and plant resources be utilized in planning resource conservation and development in the basin.

# APPENDIX H-5

My name is Eugene Chappie. I am the California assemblyman from District 6 which includes Placer and El Dorado County and 9 additional counties.

I welcome you here today Mr. Stein and representatives of California and Nevada, to learn first hand the true facts about this nationally important resource we have here in California and Nevada. The quality of the waters of Lake Tahoe are presently among the highest natural lake waters in the world. This point must be made very clear. Lake Tahoe is presently one of only 3 lakes in the world which contains water of such a high degree of purity and crystal clarity. We do, however, have a problem created by ever-increasing development and by the need for facilities to care for the ever-increasing demand placed upon this unique area by the vacationers. The local people, those who live and work here in the Tahoe Basin, were the first to recognize and strive for a solution to the potential problems. The South Tahoe Public Utility District in 1958, hired a consulting engineering firm to study and make recommendations relative to sewage disposal. The engineering report recognized the potential problem and, even at this early date, the importance of exporting all sewage from the Tahoe Basin. In this respect, the people of South Lake Tahoe have been a leader in what is now becoming a reality.

The states of California and Nevada also recognized the problem long ago and have been working diligently toward a solution. In 1958 the Lahontan Regional Water Quality Control Board passes a resolution prohibiting direct discharge of sewage or treated sewage effluent to the surface waters of the basin. The Bureau of Environmental Health of Nevada took the same steps in 1959. Much progress has been made in the last ten years and the residents of the basin have been the leaders in solving the potential problem and I must add "where else in the United States have such steps been taken to protect a natural resource?" Not by solving an existing problem, but by planning and progressing for a solution to a potential problem. The people of the basin have worked very hard toward achieving a solution well in advance of the problem because they fully recognize the value of this great resource and decided long ago to protect it for all the people of the United States to enjoy. The South Tahoe Public Utility District will this year award a contract for construction of an export line which will carry nearly all of the sewage generated in the South Shore area of California and Nevada out of the basin. The Truckee Sanitary District, North Tahoe Public Utility District, and Tahoe City Public Utility District are working together and will shortly begin construction of a section of their export line. These 3 utility districts are to be congratulated for their fine cooperation. They have progressed on their own with very little support. The Lahontan Regional Water Quality Control Board recently adopted a water quality control policy for Lake Tahoe. This is the first water quality control policy to be established on an interstate water in the United States and was forwarded to the Federal Water Pollution Control Administration a full year before the policy was required. This policy clearly establishes the present high quality of the lake waters as that quality to be maintained in allowing no degradation. The policy supports the steps taken by the local agencies in exporting their sewage. The policy goes far beyond the Federal requirements by pointing out the need for controlling factors such as shore line development and construction practices in the basin. The steps that have been taken by the people of the basin gives me great faith in their judgment. I stand ready to support, as I have in the past, if it appears that changes in state legislation are needed to control these factors. I will work closely with the people of the area to incorporate any changes in state legislation found necessary to preserve this great national resource. I hope the people will come to me and let their desires be known.

Thank you gentlemen for your time.

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